



**CALIFORNIA PARTNERS FOR ADVANCED TRANSIT
AND HIGHWAYS (PATH)**

REQUEST FOR PROPOSALS (TWO STEPS)

2005 – 2006 FUNDING YEAR

PROPOSAL DUE DATES:

PRE-PROPOSAL (STEP ONE): JANUARY 3, 2005

**FULL-PROPOSAL (STEP TWO): 30 DAYS AFTER NOTIFICATION OF
ACCEPTANCE OF PRE-PROPOSAL**

**University of California, Berkeley
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This is a Two-Step Proposal:
Step One: 3 to 4 page Pre-proposal
Step Two: Full-proposal upon request from PATH

Partners for Advanced Transit and Highways (PATH)

Request for Proposals are for the 2005-2006 Funding Year

1. OVERVIEW

The California PATH Program is a multi-campus/multi-disciplinary research program established by the California Department of Transportation (Caltrans) and administered by the PATH headquarters at the University of California Richmond Field Station. The mission of PATH is to develop innovative solutions to California's surface transportation problems. The goals of PATH are in line with Caltrans goals of improving safety, reliability, performance, flexibility and productivity of California's transportation system.

PATH is inviting proposals for research in the 2005-2006 fiscal year. PATH will consider proposals that will lead to solutions for California's surface transportation problems. Any college, university or other non-profit organization in California may submit proposals. Private companies within or outside California, and universities outside of California may also submit proposals, but these proposals must be in collaboration with a principal investigator at a California university or college. Collaboration with a university or college means that a faculty member or a research staff member at that institution will perform a significant part of the work. The roles and responsibilities of the private company and the university should be clearly delineated in the proposal. Funding is not available for proprietary product development or technology commercialization.

Highlights in this RFP:

- This year, the proposals (both Steps 1 and 2) should be submitted electronically through the PATH RFP web-site system. The submitters should adhere to the submission deadlines. Please note that the server clock shown on the RFP web site will be used to determine compliance with all deadlines.
- If you have letters of support or other additional addenda to your proposal that you are unable to submit electronically, please mail the hard copies to Alan Lochhead at the PATH Office, who will forward them to Caltrans.
- This year, the RFP includes a list of Research Problem Statements (RPS); this list was prepared by Caltrans and reflects the agency's research priorities.
- The RFP consists of two steps:
 - Step 1: Pre-proposals (3 to 4 pages) addressing topics included in the list of RPS are requested; these are due at PATH on **January 3, 2005**. Pre-proposals reviews by PATH and Caltrans will be completed in 30 to 60 days;
 - Step 2: Full proposals will be requested by PATH, only for those pre-proposals that receive a positive evaluation. Full proposals will be due **30 days after the date of notification of acceptance** of the Pre-Proposal (Step 1), and will undergo a peer-review process by academic researchers or industry experts. Caltrans Technical Advisory Panels (TAP) will perform a

parallel review process. Caltrans and PATH will make final award decisions on the basis of the results of the two review processes.

- Research expertise in transportation systems, engineering, planning and the social sciences is sought; multi-disciplinary and multi-campus proposals are encouraged in order to integrate these diverse capabilities.
- Teams consisting of faculty, students and PATH researchers are encouraged, if such teams are appropriate to the proposed research. Information about the capabilities of the PATH researchers is available on the PATH website (www.path.berkeley.edu).
- Multi-year proposals that include a Field Operational Tests (FOT) in the final year are especially encouraged where appropriate. To facilitate FOT, proposers should discuss the proposed tests with the relevant staff in the appropriate agency (Caltrans, transit agency, etc.).
- Proposers should be cognizant of the need for implementation of their results to improve transportation systems. In order to facilitate implementation, proposers are encouraged to engage in collaborations with industrial and public agency partners.
- In order to promote synergy among diverse research projects, proposers should consider how their projects could be integrated with other research projects, as well as transportation planning and deployment projects, in specific California regions or corridors.

Coordination with Current PATH Research

PATH currently has research projects underway that are related to many of the research topics, as well as significant test bed activities throughout the state (See Appendix B).

Proposers are encouraged to coordinate their proposals with these efforts.

Abstracts of existing PATH projects can also be obtained on-line on the Web

(<http://www.path.berkeley.edu>)

This RFP is organized as follows:

- PATH research needs for the coming year
- Funding restrictions
- Pre-proposal format, submission and evaluation (Step 1)
- Full proposal format (Step 2)
- Full proposal evaluation (Step 2)
- Submittal of full proposal (Step 2)

This document is available on-line in Adobe Acrobat at the PATH website:
<http://www.path.berkeley.edu/rfp>

2. RESEARCH NEEDS

This section outlines PATH research needs for this year, reflecting Caltrans' list of Research Problem Statements.

Introduction

The annual PATH Request For Proposals (RFP) to perform Caltrans' sponsored research is based on problem statements derived from customer needs. This research focuses on the application of innovative solutions to meet Caltrans' mission of **improving mobility across California**. This research will specifically address the following Caltrans goals:

- **SAFETY:** achieve the best safety record in the nation
- **RELIABILITY:** reduce traveler delays due to roadwork and incidents
- **PERFORMANCE:** deliver record levels of transportation system improvements
- **FLEXIBILITY:** make transit (and other HOV modes) more practical travel options
- **PRODUCTIVITY:** improve the efficiency of the transportation system

The Research Problem Statements (RPS) in this RFP have been identified by the Caltrans Division of Research and Innovation (DRI) in collaboration with internal department customers including Caltrans Districts and Divisions and California researchers. Some RPS were generated during the PATH-Caltrans workshops that took place in July and August 2004.

Research Problem Statements (RPS)

The complete list of Research Problem Statements is included below with a detailed discussion of each topic following the list. Each RPS has a unique identification number, which is used by Caltrans for tracking purposes within the organization. The RPS identification number, shown in the first column of the following table, should be included in the title of the pre-proposal.

EV-503	Improved Application of Geophysical Remote Sensing in Environmental Studies
MA-504	Improve security at Safety Roadside Rest Areas
MA-505	Improve communications interoperability among responders.
MO-501	Field Operational Tests of Adaptive Transit Signal Priority (ATSP)
MO-502	Efficient Deployment of Advanced Public Transportation Systems (EDAPTS)– Cost/Benefit Evaluation
MO-503	The Development of Performance-Based Specifications for Efficient Deployment of Advanced Public Transportation Systems (EDAPTS).
MO-504	Stage 5 Test Deployment of Efficient Deployment of Advanced Public Transportation Systems (EDAPTS)
MO-505	Evaluation of Cost-Effective Planning and Design Options for BRT in Dedicated Bus Lanes
MO-506	Establish Infrastructure Requirements for Lane Assist/Precision Docking
MO-507	Field Demonstration and Tests of Lane Assist/Guidance and Precision Docking Technology
MO-508	Evaluating Enhanced Transit Strategies at Transit Oriented Developments
MO-509	Effective Means for Rapid Restoring Energy for Electric Transit Buses

PS-502	Survey: Understanding Heavy Truck Travel Patterns in Southern California
PS-503	Consumer-Driven Functional Requirements for Travel Information
PS-504	Removing Barriers for Seniors at Transit Stops and Stations and the Potential for Transit Ridership Growth
PS-505	Policy Analysis and Planning for Hydrogen Energy and Distributed Power
TS-506	Deliver a Set of Tools to Resolving Bad Inductive Loops and Correcting Bad Data
TS-508	Field Element Effectiveness
TS-509	Evaluation of Portable Automated Data Collection Technologies
TS-513	Optimal use of CMS for Displaying Travel Times
TS-515	Optimal Sensor Requirements for Traffic Management and Traveler Information Applications
TS-516	Bicycle Detection and Operational Concept at Signalized Intersections
TS-519	Weave Analysis Evaluation and Refinement
TS-520	Animal Warning System Effectiveness
XB-501	Cooperative Intersection Collision Avoidance (CICA)
XB-502	Virtual Weigh and Compliance Station Test-bed <Phase 1 of the Virtual Weigh and Compliance Station Development Program>
XB-503	Feasibility Study for the Use of Biodiesel in the Caltrans Fleet

RPS: #EV-503

I – Problem Title

Improved Application of Geophysical Remote Sensing in Environmental Studies

II – Research Problem Statement

Geophysical remote sensing developed for large-scale applications such as geological prospecting for minerals are underdeveloped for smaller scale, site specific environmental uses such as Cultural Resource Management. The application of this technology for environmental purposes by State DOT's has been piecemeal preventing full realization of the scientific and project delivery benefits.

III – Objectives

Develop appropriate protocols for the various forms of geophysical remote sensing as applied to subsurface characterization of cultural deposits. These protocols include: 1) Establishment of proper field methodology for the various geophysical technologies for both in-house and contracted work. 2) Development of a questionnaire for determining the appropriate geophysical techniques for any given project with historical resources. 3) Development of 'Scope of Work' parameters to ensure the public's interests are met and maximum efficiencies are achieved when incorporating geophysical work into contracts and task order language.

IV – Background

Caltrans has been a leader in utilizing geophysical technology and has demonstrated the applicability of this technology for cultural studies on several projects over the past three

years. The next step is to refine the use of geophysical tools available for cultural studies. The body of literature dedicated to expected results and methodological protocols in varying contexts is inadequate. Because of the lack of expectations and protocols, our ability to determine the most effective approach to geophysical remote sensing under varying site conditions is limited.

V – Statement of Urgency and Benefits

Recent inquiries by other state and federal agencies (TransArch Listserv membership includes DOT's, BLM, USDA, and others), indicate the desire to incorporate these technologies into mainstream cultural studies. However, there is a large gap in understanding. By mainstreaming these technologies through development of these protocols one can expect expedited project studies with higher quality results and increased workload efficiency. Additional benefits will be achieved when consulting with state and federal regulatory agencies by adding another level of crucial data to support determinations of eligibility, findings of effect and treatment proposals. There are also potential crossover benefits through application in other environmental disciplines such as biology and hazardous waste investigations.

VI – Related Research

Weymouth, John (1986) Geophysical Methods of Archaeological Site Surveying. *Advances in Archaeological Method and Theory*, Vol. 9, Pp. 311-395.
 Plog, S., F. Plog, and W. Wait (1978) Decision making in modern surveys. In *Advances in Archaeological Method and Theory*, Vol 1. edited by M. Schiffer, New York: Academic Press, Pp. 383-421.

VII – Deployment Potential

The final product will be an innovative, iterative tool for use by cultural and remote sensing specialists to determine what forms of geophysical remote sensing should be applied in various archaeological settings and assist in interpretation of geophysical survey results by agency staff. The results will provide information for environmental decision-making and provide the Department(s), partner agencies, other agencies, SHPO, and contractors with guidance on the effective use of geophysical remote sensing for cultural resources investigations. Further, it will help staff determine what is the most appropriate course of action to take and how to incorporate those actions into procurement specifications used to hire geophysical specialists.

RPS: #MA-504

I – Problem Title

Improve security at Safety Roadside Rest Areas

II – Research Problem Statement

Research and identify methods and measures to enhance the security and safety of rest area patrons.

III – Objective

Improve the safety and security of the rest area system, which will encourage tired motorists to utilize the facilities, especially at night. Rested motorists will decrease highway accidents and improve mobility across California. Provide secure rest areas that will improve the public's perception of our facilities and reduce vandalism and associated costs.

IV – Background

California's Safety Roadside Rest Area system does not present a secure environment to motorists using these facilities, especially at night. Public perception is that the majority of rest areas are not safe to use during the nighttime. Historically the majority of nighttime users are truckers who can seek refuge in their trucks. Past surveys of rest area patrons revealed that personal security and safety was a leading concern. A significant percentage of senior citizens and women do not use rest areas during the dark hours due to personal safety concerns.

V -Statement of Urgency, Benefits, and Expected Return on Investment

Rest areas are an integral part of improving mobility across the state and need to be a safe and secure place for anyone who uses them. Successfully improving the security and safety in rest areas will increase the number of users and remove tired motorists from the highways. Improving the security will reduce vandalism and save maintenance and operational resources also. Additionally this will reduce complaints from the traveling public and improve the overall image of the facilities we provide.

VI – Related Research

Caltrans Level of Service reviews and past rest area surveys.

VII - Deployment Potential

Research should identify specific safety and security issues that have contributed to the traveling public's perception of rest areas. Improved lighting, installing surveillance cameras, contracting with security personnel, or establishing a rest area host program could be initiated to meet the objective.

RPS: #MA-505

I - Problem Title

Improve communications interoperability among responders.

II – Research Problem Statement

Because of disparate communications systems, public safety agencies responding to incidents or emergencies are not able to readily communicate via 2-way radios. How can we achieve communications interoperability leveraging existing State and local communications systems?

III – Objective

Improve essential communications between public safety agencies; and improve incident response and recovery to minimize loss of life and property.

IV – Background

Historically, State departments have implemented communications systems to fulfill their individual needs, with minimal or no ability to communicate between themselves. DGS' approach for radio interoperability is to build a new statewide communications system that is very costly, a lengthy implementation schedule and does not include or leverage existing regional communications systems. Caltrans is one of the largest civilian departments, with resources geographically located throughout the State, and has established an effective relationship with contractors able to perform disaster response and recovery. Thus Caltrans has a need to communicate with everyone.

VI – Statement of Urgency

Implementation of solutions should be as quick as possible as disasters or emergencies can occur at anytime.

VI – Related Research

Florida and Pennsylvania are in the process of implementing a statewide communications system. San Diego County and Sacramento County have implemented a regional communications system. Lessons learned from the Oakland Hills Fire, the September 11 terrorist attacks and the Governor's Blue Ribbon report with respect to the Southern California fires.

VII – Deployment Potential

Solution can be deployed in phases. As mentioned in Section VI, there have already been regional communications systems in operation for a number of years. There are products available today that allows for integration of different communications systems that provides a certain degree of interoperability.

RPS: #MO-501

I – Problem Title

Field Operational Tests of Adaptive Transit Signal Priority (ATSP)

II – Research Problem Statement

Prevailing active TSP systems may cause additional noticeable delay to the minor-phase traffic. An ATSP system has been developed that grants transit priority at the same time it limits the impacts on the minor-phase traffic and ensures pedestrian safety. A field operational test is needed to further evaluate/validate the system, refine the system and transform the system from a prototype to a readily deployable system.

III – Objective

The goal is, through a large-scale implementation, to develop and validate a deployable cost-effective ATSP system that takes advantage of the existing AVL/ACS (Advanced Communications System) equipped on BRT buses. The objectives are to:

1. Investigate a robust and efficient system architecture for a large-scale deployment of the developed ATSP system and determining the corresponding communications links, means and protocols;

2. Work with ACS vendors (Orbital or Siemens) to modify the ACS to incorporate the dynamic polling or alternative means for making priority calls using existing ACS;
3. Develop a more advanced priority request server to manage and prioritize the requests generated from multiple buses;
4. Work with transit agencies (SamTrans) and district 4 to implement and integrate the ATSP system along El Camino Real with 50 + intersections and 50 buses;
5. Evaluate system and perform demonstration.

This research contributes to the Caltrans Vision and Mission for Mobility, Reliability and Productivity.

IV – Background

California PATH Program, in partnership with Caltrans Headquarters, District 4 and San Mateo County Transit Authority (Samtrans) has been conducting a research program to investigate an ATSP system. The developed TSP system utilizes GPS equipped on buses to continuously monitor bus movements, and the resulting historical and online bus data to predict bus arrival times at signalized intersections. A TSP algorithm uses the information of predicted bus arrival time, queue charging time, signal status, and pedestrian presence to determine the signal timing strategy for bus priority, with the objectives of limiting negative impacts on the minor-phase traffic and ensuring pedestrian safety. Since GPS and ACS have already been deployed on transit buses by many transit agencies, the PATH ATSP approach allows for all buses instrumented with GPS/ACS to become signal priority capable without additional equipment on buses. It is therefore a most cost effective and integrated approach for deployment of signal priority systems. To date, PATH, with assistance of Caltrans and Samtrans, has demonstrated the viability of ATSP concept through Paramics simulation and a limited scope of field operational test (three intersections along El Camino Real and a testing vehicle). PATH and Caltrans are now investigating the potential impediments to the deployment of this GPS-based ATSP system, including development of methodologies to extend the capability of the existing GPS/ACS systems to include signal priority features and improvement of the TSP algorithm to better accommodate bus signal priority calls while minimizing the impact to the other traffic and maintaining the coordination among signals.

V – Statement of Urgency and Benefits

Implementation of TSP may reduce bus intersection delay and travel time, improve bus service reliability and reduce transit operating cost, air pollution and noise. ATSP system will be more successful in terms of acceptance by the transit agency and traffic authority and of promoting widespread use of TSP. Samtrans is highly motivated in promoting this project and has allocated 05/06 capital funding for the project.

VI – Related Research

Zhang, W.B. et al. Development of Adaptive Transit Signal Priority Systems, University of California, Berkeley: Institute of Transportation Studies, California PATH Program, (Draft) PATH Research Report UCB-ITS-PRR-2004, August 2004.

VII – Deployment Potential

The research product will be an AVL/ACS-based ATSP system for actuated signalized corridors, which is readily deployable for real implementations.

RPS: #MO-502

I – Problem Title

Efficient Deployment of Advanced Public Transportation Systems (EDAPTS)–
Cost/Benefit Evaluation

II – Research Problem Statement

The prototype EDAPTS Smart Transit system is currently operational in San Luis Obispo, California where it is operated and managed by San Luis Obispo Transit (SLO Transit). While, it provides a variety of user and administrative services on a daily basis, there has been only a limited data analysis to demonstrate system benefits to the transit operator, employees, riders, and to the community at large. An expanded analysis is needed.

III – Objective

An expanded evaluation of the recently completed EDAPTS Smart Transit System prototype testing (Stage 4 of the DRI Deployment Path Process) to determine if the system actually provided significant quantitative and/or qualitative benefits to passengers, drivers, dispatchers, and transit manager. It is anticipated that the findings of this study can be used to quantify and validate the cost-benefits of deploying these types of low cost Intelligent Transportation System (ITS) solutions in other similar locations, as well as validate the need for any further research and/or deployment efforts on this specific research project.

IV – Background

Transit users in small urban and rural communities often face significant problems when trying to use transit as a viable and reliable mode of transportation. Improvements to transit service, especially in the form of increased safety, improved on-time performance, improved customer service, and ease of making a intermodal or multimodal connection, can help make transit a better transportation alternative for users and can also improve operational efficiency for providers. Smaller transit properties could potentially benefit from the application of technology-based solutions; however, they are often confronted with budgetary and technical limitations that prevent them from selecting and applying new technology to solve operational problems or to improve customer service levels. They may choose to apply these solutions if it can be shown that a clear cost-benefit ratio exists, but only if those solutions are affordable for them. The goal of the EDAPTS project is to enable these smaller transit properties to attain technology assisted improvements by using tailored ITS solutions optimized for the lowest possible cost. From early 2002 through mid 2003, the prototype EDAPTS system was deployed in the City of San Luis Obispo by a partnership consisting of Caltrans, California Polytechnic State University, and SLO Transit. A significant amount of operational data was collected during the project period and is available in the existing schedule adherence database archives. Analysis of this test period data, in conjunction with an analysis of existing and historical operational data, interviews with personnel from SLO Transit and

surveys of local transit users can provide useful indications as to the real benefits and costs of this system in the small agency environment. This can then be compared with other cost/benefit studies and evaluations of similar ITS systems at other agencies that have implemented and deployed similar commercial ITS solutions. The results will be used to help validate (or nullify) the need to continue efforts to commercialize all or parts of the EDAPTS Smart Transit System.

V – Statement of Urgency and Benefits

EDAPTS is ready for advanced Stage 5 deployment activities, and funding for this effort is needed now. An evaluation of the San Luis Obispo system will determine if the performance and service level improvements obtained in the test location justify the continued application of research and other funding dollars.

VI – Related Research

Efficient Deployment of Advanced Public Transportation Systems– Phase 2, EDAPTS: A Smart Transit System for Small Transit Agencies. Jeffrey Brian Gerfen, Principal Research Engineer, California Polytechnic State University at San Luis Obispo, California, June 30, 2003.

VII – Deployment Potential

SLO Transit is currently funding and still utilizing the prototype EDAPTS Smart Transit Systems in daily operations, so it is a highly desirable system for them. Other small transit properties have shown significant interest in procuring an EDAPTS Smart Transit System, but no commercial supplier exists. Positive results from this study can be utilized as a marketing tool to present the EDAPTS concept to other transit agencies and help bring private industry suppliers into the market with this type of product. Conversely, negative results will be useful in making a determination that this area does not warrant the expenditure of future public funds.

RPS #MO-503

I – Problem Title

The Development of Performance-Based Specifications for Efficient Deployment of Advanced Public Transportation Systems (EDAPTS)

II – Research Problem Statement

The Stage 4 research activities for EDAPTS prototype hardware are complete and continued Stage 5 deployment activities necessitate the development of performance-based specifications. These specifications will be based on user needs and will reflect current best value technology available via off the shelf procurement methodologies.

III – Objective

Implemented on a local, regional, or statewide basis, EDAPTS has the potential to provide significant benefits to riders, transit staff and management in smaller transit agencies. This includes increased operations efficiency, improved customer service levels, and improved driver and passenger safety. This research contributes to the Caltrans Vision and Mission for safety, reliability, flexibility, and productivity.

IV – Background

Effective ITS based problem solutions for small to medium sized transit systems typically do not require all of the features and/or performance levels seen in a larger-scale transit management system that is deployed in a highly urbanized or metropolitan area. The EDAPTS concept is breaking new ground since it is designed from the ground up based on Transit Communications Interface Protocols (TCIP) and the National ITS Architecture to provide expandable/contractible systems that provide standardized hooks and links to other Architecture compliant systems. The EDAPTS Smart Transit System is installed and operational in San Luis Obispo and is well accepted by the local transit system partner and other stakeholders

V – Statement of Urgency and Benefits

The urgency for this research is based on the Stage 5 classification of the EDAPTS project and the need for technical specifications for the purpose of full deployment and commercialization of EDAPTS to continue.

VI – Related Research

Efficient Deployment of Advanced Public Transportation Systems – Phase 2, EDAPTS: A Smart Transit System for Small Transit Agencies. Jeffrey Brian Gerfen, Principal Research Engineer, California Polytechnic State University at San Luis Obispo, California, June 30, 2003.

VII – Deployment Potential

The research for EDAPTS is in Stage 5. The estimated benefits are significant and there appears to be substantial interest in this type of ITS system if commercial suppliers can be found and/or developed. Performance specifications are essential if the system is to be made ready for commercialization and full deployment in small to medium sized transit agencies.

RPS: #MO-504

I – Problem Title

Stage 5 Test Deployment of Efficient Deployment of Advanced Public Transportation Systems (EDAPTS)

II – Research Problem Statement

A prototype EDAPTS system is currently operational in San Luis Obispo, California. Currently research proposals are being submitted that are intended to determine the cost/benefit of EDAPTS type systems and to fund completion of performance based specifications. Assuming positive results in both those proposed efforts, the logical next step in the EDAPTS deployment process is to find a small to medium rural transit operator with a limited number of buses who is willing to utilize the specifications and open source EDAPTS design in a Stage 5 trial deployment on their system. This trial would consist of a small EDAPTS system deployment that evaluates whether the transit operator can independently implement the EDAPTS system using the specifications and designs. If EDAPTS proves itself to be useful and “transit operator friendly” it is

anticipated that private company suppliers will be interested in supplying the product and post-installation support. If private suppliers can be developed, other California small transit operators will be able to implement EDAPTS in their service areas.

III – Objective

The Stage 5 trial deployment effort is necessary to determine whether a rural transit operator, using “off the shelf” components that match the performance specifications, can install an EDAPTS system. If successful, this project has the potential of improving small transit service statewide and nationwide. Since the Intelligent Transportation System (ITS) components provide significant operator advantages and enhance the reliability and overall trip experience for the transit rider, it is anticipated that an increase in daily ridership may occur. Increased transit ridership can reduce air pollution, automobile fuel consumption and traffic congestion, all of which are goals of the Department and the State. The potential bus operator should have a limited number of buses (10 max) and access to matching funds for the project. The intent is to implement several or all of the EDAPTS technological components.

IV – Background

The EDAPTS project was a Caltrans sponsored research project developed in partnership with California Polytechnic State University (Cal Poly), and the City of San Luis Obispo. The EDAPTS research and design project gave engineering students from Cal Poly an opportunity to develop a transit ITS system that would have practical application to the targeted small transit agency end user, which was represented in the research project by the City of San Luis Obispo’s transit system (SLO Transit). The system has completed the prototype research phase and the City and University have jointly assumed responsibility for continued daily operation of the prototype system.

V – Statement of Urgency and Benefits

Full Stage 5 deployment and project implementation is dependent upon preceding project outcomes as described above.

VI – Related Research

There are a multitude of articles on the Web pertaining to Intelligent Transportation Systems (ITS) for transit. Some of them, include a federal article, “Transit Goes High-Tech”, which discusses different components of ITS, such as a global positioning system (GPS), and electronic payment system, both of which are components of EDAPTS. One very comprehensive report, “Rural Transit ITS Best Practices” completed by several private consultants for Intelligent Transportation Systems (ITS) Joint Program Office (JPO) and the Federal Transit Administration (FTA) presents case studies from across the nation (Texas, New Mexico, Iowa, Pennsylvania, Florida) where different types of technology have been deployed including communication systems, scheduling and dispatching software, automatic vehicle location (AVL), electronic fare systems, and others. This is an excellent resource that even includes a glossary of technological terms relating to transit.

VII – Deployment Potential

Assuming a successful test deployment, the potential for deployment of the EDAPTS Smart Transit System is rated high. This product will make available to small transit properties ITS solutions that bring significant operational and customer service level improvements with a cost of operation that they can afford. The unique solar powered dynamic messaging signs are likely to be extremely useful in all transit environments, large or small, since they require minimal infrastructure improvements for installation

RPS: #MO-505

I – Problem Title

Evaluation of Cost-Effective Planning and Design Options for BRT in Dedicated Bus Lanes

II – Research Problem Statement

Many California transit agencies are planning to deploy BRT and considering the use of dedicated lanes for BRT. Dedicated right-of-way for BRT is highly desirable as it is less affected by automobile traffic, thereby providing rail-like quality of service. However, the option of BRT with two dedicated lanes becomes difficult to implement for a number of reasons. Evaluation of cost effective planning and design options is needed to assist transit agencies to reduce the need for dedicated rights of way and yet still deliver rail-like quality of service.

III – Objective

The objectives of this proposed study are (1) to define and evaluate innovative design and technology options for dedicated BRT systems that will use less right-of-way yet offer similar level of service to a two-lane dedicated BRT, (2) to evaluate the benefits, impacts and cost-effectiveness of these innovative design and technology options and (3) to develop analysis methods, planning guidelines and deployment strategies for cost effective dedicated-lane BRT systems.

IV – Background

BRT has demonstrated its effectiveness to be a portion of the ‘backbone’ of an integrated transit network. It has become an effective means for attracting non-traditional transit riders and therefore can help to reduce urban transportation needs and traffic congestion. Among the design options, the use of dedicated lanes for BRT is highly desirable as it is less affected by automobile traffic, thereby providing rail-like quality of service. However, the option of BRT with two dedicated lanes becomes difficult to implement for a number of reasons, including:

- Physical, institutional and financial constraints to road expansion
- Impact to other traffic as the result of taking existing general-use lanes for BRT
- Allocation of full right-of-way and construction cost for dedicated bus lanes.

Recent technological innovations such as electronic guidance (lane assist) and innovative BRT operating concepts involving designs that not only fit into the existing road and traffic environment but also create minimum impact to other traffic offer potential solutions for overcoming these obstacles. For example, a BRT system using a combination of lane assist technology and a single bi-directional BRT lane could provide light rail-equivalent capacity while only using one dedicated lane between stations.

Modern vehicle tracking, signaling and guidance technology should make it possible to ensure safe bi-directional operation within the single lane, in ways that could not be accomplished previously.

These innovative designs and technologies will help to reduce the need for dedicated rights of way and yet still deliver performance and quality of service similar to a two-lane dedicated BRT system. By incorporating these innovative technologies and designs into the BRT planning, rail-like dedicated BRT service then becomes technically feasible at locations where two full-size dedicated lanes are not possible. Furthermore, the large cost reduction for constructing dedicated bus lanes, the significantly reduced impact to the existing traffic and the reduced institutional impact could make a dedicated BRT system possible for more deployment sites. The results of this study will serve statewide (and nationwide) BRT interested transit agencies for their BRT deployment planning by providing them with additional options.

V – Statement of Urgency and Benefits

BRT interested transit agencies are considering dedicated BRT lanes. AC Transit has launched a BRT project that includes dedicated BRT lanes. They urgently need this research to assist them in selecting a cost-effective design and planning prior to the construction starting 2006. Los Angeles County MTA has also decided to introduce a dedicated BRT lane onto the Wilshire BRT in order to enhance its performance and is also in need of this research to assist its design and planning that not only fits into the existing road and traffic environment but also creates minimum impact to other traffic and offers potential solutions to help overcome deployment obstacles.

VI – Related Research

N/A

VII – Deployment Potential

Analysis methods, planning guidelines and deployment strategies for cost effective dedicated-lane BRT systems will be developed as products of this study, and can be deployed statewide for regional or multi-regional planning statewide.

RPS #MO-506

I - Problem Title

Establish Infrastructure Requirements for Lane Assist/Precision Docking

II - Research Problem Statement

BRT using dedicated lanes with Lane Assist/Precision Docking will likely have infrastructure requirements dictated by the new technology. Lane Assist guides the bus along a very precise track over the line-haul portion of bus routes. The technology permits narrower lanes than would otherwise be possible. However, the passage of the bus over the exact location will over time likely result in a degradation of pavement quality, increasing maintenance costs and adversely affecting the lane assist accuracy. Precision docking, at its highest level of precision, enables the bus to maintain close tolerances with the curb and boarding platform. This will likely reduce dwell times and may obviate the need for wheelchair ramp deployments. However, to function properly,

the curb and boarding platform design needs to be integrated with the Precision Docking technology to achieve the close tolerances needed.

III – Objective

- Evaluate the impact of Lane Assist on pavement life
- Document the impact of Lane Assist on pavement lifecycle costs
- Create cost-effective design options for pavement treatments to solve the unique wear patterns possible with Lane Assist
- Establish standards for pavement durability and ride quality for BRT systems using Lane Assist
- Create design guidelines for bus boarding platforms and bus approaches where precision docking is employed
- Establish the roadway parameters at boarding platforms for precision docking (e.g. crown, curb height, slope, etc.)

IV - Background

(Not provided)

V - Statement of Urgency and Benefits

Deploying a lane assist system could reduce the right-of-way requirements, minimize parking loss, improve traffic flow and accommodate bike lanes. The benefits of lane assist system are two folds: (1) to offer significant cost saving for a dedicated lane by minimizing alignment change and by cutting the cost down for renovation of the dedicated lane, and (2) to minimize the institutional barriers for a dedicated BRT corridor. However, the lane assist technology may accelerate the degradation of the pavement. As efforts are made by transit operators to deploy lane assist system, the pavement design issues need to be addressed. As an example, AC Transit will begin designing its BRT project in 2005. The current approach of the agency is to utilize existing pavement wherever possible. Before the design process can begin, AC Transit would need to know exactly what pavement improvements would be needed in order to use the lane assist technology. Similarly, AC Transit would need to specify standards for BRT station boarding platforms at the outset of the design process to ensure successful implementation of precision docking.

VI – Related Research

Significant studies on lane assist technologies have been conducted. There have been considerations of applying double track concrete designs that provide the strength and durability for guided buses and at the same time minimize the pavement areas. However, there hasn't been detailed infrastructure study.

VII – Deployment Potential

Implementing Lane Assist technology has been put in BRT interested transit agencies' agenda. In California, AC Transit, LACMTA, San Diego Sacramento RTA are all interested in considering lane assist technology in their future BRT system. For example AC Transit has included a two dedicated BRT lane in their East Bay BRT RAPID Program and scheduled to start construction in 2007. The outcome of this project will benefit transit agencies statewide in deployment of the technology that provides 'rail-

like' features that enhance efficiency, safety and quality of service for transit operations. As results, it will help attract more transit riders.

RPS: #MO-507

I – Problem Title

Field Demonstration and Tests of Lane Assist/Guidance and Precision Docking Technology

II – Research Problem Statement

A lane assist/guidance technology developed from previous projects enables buses to operate along narrow bus lanes at higher speed and to precisely dock at bus stops. Demonstrations at various locations have been well received, and several transit agencies are considering/planning to implement it to their new BRT programs. A scaled field demonstration and controlled test is needed prior to the deployment.

III – Objective

1. To implement lane assist/guidance system at select transit agencies.
2. To conduct controlled field test at a selected lane site(s).
3. To conduct controlled field test at a select maintenance yard.
4. Test evaluation and recommendation for deployment

IV – Background

A promising enabling ITS technologies for BRT is electronic guidance, to provide lane assistance and precision docking functions, allowing the bus to operate in a designated lane that is only inches wider than the bus itself without increasing driver workload. It can be implemented with partial or fully automated modes to guide buses through narrow bridges, tunnels, toll booths, and roadways, as well as bus stops, tight curves, and designated trajectories in maintenance yards. Transit agencies, particularly the ones that are planning to deploy BRT systems, have show significant interest in lane assist and precision docking technologies. The cost benefit analyses have shown that these technologies will offer great benefits for improving operation, safety, productivity and cost effectiveness for transit.

Under the sponsorship of Caltrans and federal DOT, lane assist technologies have been under development for the past 15 years, gradually become mature and near the deployment. Recently, FTA and Caltrans have funded an effort to define the performance requirement specifications. Transit industry has requested that field test be conducted in order to enhance and verify the technology for deployment

V – Statement of Urgency and Benefits

Implementing Lane Assist technology has been put in some transit agencies' agenda. AC Transit has included two dedicated BRT lanes in their East Bay BRT RAPID Program and scheduled to start construction in 2007. It is essential that this scaled field demo/test be conducted in FY 05/06 in order to contribute toward design and construction decisions. The outcome of this project will benefit transit agencies statewide in deployment of the technology that provides 'rail-like' features that enhance efficiency, safety and quality of service for transit operations.

VI – Related Research

The research conducted as part of Transit IVI program led by US DOT and FTA includes:

- BRT Lane Assist Technology Systems by Metro Transit and Univ. of Minnesota, assessed related technologies and bus driver stresses while driving on narrow dedicated bus shoulders.
- Lane Assist/Guidance Project by PATH, conducted case studies with AC, LACMTA, San Diego, and Lane County Transit to gather transit needs and developed a set of lane assist requirements.
- Lane Assist Interface requirements by PATH to develop interface requirements for the lane assist systems and the vehicles allowing maximum compatibility, and interface requirements for vehicle to roadway infrastructure interface, and conduct test on service buses to test/validate the requirements.

VII – Deployment Potential

This is an incremental part of a multi-year research project under Transit IVI Program and has reached Stage 4 in the deployment cycle defined by DRI.

RPS: #MO-508

I – Problem Title

Evaluating Enhanced Transit Strategies at Transit Oriented Developments

II – Research Problem Statement

California's population is over 36 million and is expected to grow by about 10 percent (or 3.6 million new residents) by 2010. Motor vehicle travel in the State is expected to grow from 408 billion miles traveled in 2003 to over 475 billion miles traveled in 2010, and California's peak electricity demand is expected to increase from about 63 megawatts in 2003-2004 to 67 to 70 megawatts in 2010. To accommodate this growth—and potentially help to mitigate it—the State's transportation and energy systems will need to provide more efficient and flexible options. Many transit surveys indicate a demand for more flexible and reliable “integrated” door-to-door services to reduce total travel times and increase ridership. Transit Oriented Developments (or TODs) offer one innovative approach to increase the attractiveness of transit services. TODs also provide an opportunity to design, construct, and test how new designs that might improve connectivity and quality of life, reduce congestion, and employ energy efficient technologies in key locations throughout the State.

III – Objective

1. Conduct a feasibility study that incorporates multiple transit connectivity services (e.g., carsharing, shared-use bikes and other low-speed modes, and traveler information), as well as clean fuel technologies, in a single location.
2. Test various innovations, simultaneously, in a TOD environment (planned or existing).

3. Evaluate collective effectiveness of various innovations to develop recommendations for optimal integration of appropriate solutions for TOD locations (with the potential to influence design prior to construction, where appropriate).

IV – Background

TODs offer one innovative approach to increasing the attractiveness of transit services and to addressing the root problem of increasing mobility demand. By clustering residential units and retail/commercial activities near transit stations, transit use becomes more practical and mobility requirements in general can be reduced through “urban sprawl” mitigation. In essence, TODs put transportation “attractors” close to transit services and engender a higher density urban form that—if carefully designed—also provides for a high quality of life for those living in and near the TOD. In doing so, TODs make transit use more attractive, and they therefore can make transit systems more economically efficient, reduce transportation energy consumption and greenhouse gas emissions, and improve quality of life and air quality.

TODs, thus, offer an attractive approach to addressing transportation problems. The clustering of transit services and residential/retail/commercial activities around TODs also makes them ideal sites for the integration of innovative energy strategies along with transportation services. Energy issues have become prominent in California in recent years as a result of the failed attempt at electricity market deregulation and resulting high prices for electricity services, high gasoline prices, and difficulty in developing the infrastructure to support continuing growth in electricity and natural gas demand.

As part of a strategy to address these issues, on April 20, 2004, Governor Schwarzenegger unveiled a plan to explore the potential of hydrogen to provide stationary and mobile power as part of a “California Hydrogen Highway Network” initiative. This effort is expected to be closely coordinated with a \$190 million five-year U.S. Department of Energy program to demonstrate hydrogen-powered vehicles and associated infrastructure, with a significant locus of these activities in California. Also relevant are recent efforts to expand solar power in the State, through incentive programs, local bond measures, and requirements for a percentage of solar power installations in new developments.

V – Statement of Urgency and Benefits

California's projected population growth, energy demand, and motor vehicle travel projections are significant. Creative mobility, land use, and energy solutions are needed. Research and evaluation of integrated strategies should be considered and tested in concert to assess their collective benefits, amass lessons learned, and potentially affect future and current land use patterns/designs.

This problem statement addresses several Caltrans goals and California Transportation Plan (CTP) goals:

- Flexibility: Make transit a more practical travel option.
- Productivity: Improve the efficiency of the transportation system.
- CTP Goal 3: Improve mobility and accessibility (policy—manage and operate an efficient intermodal transportation system)—enhance connectivity between transportation modes, including motorized and unmotorized.
- CTP Goal 3: Improve mobility and accessibility (policy—increase system capacity)—expand shared car programs, such as carsharing where proven effective.

- CTP Goal 3: Improve mobility and accessibility (policy—provide viable transportation choices)—expand market share of cleaner vehicles and supporting fuel infrastructure.
- CTP Goal 3: Improve mobility and accessibility (policy—provide viable transportation choices)—evaluate projects such as CarLink to determine effectiveness, identify winning attributes, and deploy on a wider basis.
- CTP Goal 5: Enhance the environment—Commit to a clean and energy efficient system.

VI – Related Research

This research is grounded in a wide variety of related research topics, previously researched and currently underway, including the following California Partners for Advanced Transit and Highways (PATH) projects:

- CarLink I & II
- Smart Parking Management
- Low-Speed Modes Linked to Transit
- Enhanced Transit Strategies
- Integrated Hydrogen/Intelligent Transportation Systems (ITS) Evaluation
- Clean Hydrogen for Transportation Applications
- California Trains Connected (WiFi)

VII – Deployment Potential

This integrated systems approach (Evaluating Enhanced Transit Strategies at Transit Oriented Developments) has great deployment potential. Many of the concepts have been tested, but not yet in one place. There are numerous locations where this could be deployed in the State. There is significant potential to amass lessons learned that could be put into practice in existing and planned TODs.

RPS: #MO-509

I - Problem Title

Effective Means for Rapid Restoring Energy for Electric Transit Buses

II - Problem Statement

Battery powered electrical buses is a desirable transit solution for providing efficient and environmental friendly public transportation. However, current battery technology has limited the size (particularly the weight) of transit buses that can be powered by batteries (specifically due to the consideration of battery weight vs. passenger weight ratio). Furthermore, the low battery recharge rate has prevented battery powered electric buses from traveling at a longer distance. Fast and efficient power restoring while buses are in service operation becomes critical for battery-powered buses to compete with traditional diesel/gas-powered buses.

III - Objective

To develop a fast power restoring technology in order to allow electric transit buses to carry maximum number of passengers and travel as conventional transit vehicles without distance limitation.

IV - Background

Electrical buses have been considered as a desirable means for providing efficient and environmental friendly public transportation. Available alternatives include trolley buses with overhanging electric cable, battery-powered electric buses, roadway electrification, and recently hybrid fuel and electric buses. Trolley buses have the constraint of running only in fixed routes, and overhanging electric cables are not acceptable by many cities. Roadway electrification requires expensive roadway infrastructure and the efficiency for power pick up has been low. The hybrid engine significantly improves the fuel efficiency but still produces emission and noise. Battery-powered electric buses are efficient, clean and low noise. However, they require a significant number of battery units to be installed in order to provide a reasonable travel distance. The batteries add a lot of weight to the vehicle and limit the size of the bus that battery can power and the distance the bus may travel. The low recharge rate and long backup time have also limited the applications of the electric bus. The road test of Santa Barbara electric bus project has successfully shown the recharge rate of 1 mile per minute with Zebra batteries. However, in-service energy restoring would require a much faster recharge rate.

V - Statement of Urgency and Benefits

Battery-powered electric buses are highly desirable by transit agencies. However the limitations of batteries have greatly hindered the application of battery-powered electric buses. Rapid power restoring becomes a critical issue for practical use of electric buses in transit service. If fast power restoring can be achieved, electric buses will become a better choice for transit agencies. Therefore, this research has significant impact to transit industry.

VI - Related Research

PATH has pioneered research on roadway electrification. Caltrans recently has collaborated with the city of Santa Barbara on testing of electric buses using advanced batteries.

VII - Deployment Potential

This research will involve research, field operational tests and evaluation. The fast power restoring technology is in great need for transit operation and therefore has great deployment value. The project will form a partnership with researchers, transit agencies, bus manufacturers and battery suppliers to develop the fast restoring technology and transfer this technology to transit manufacturers.

RPS: #PS-502

I – Problem Title

Survey: Understanding Heavy Truck Travel Patterns in Southern California.

II – Research Problem Statement

It is proposed to do a survey to evaluate truck travel patterns at key public facilities along heavy freight corridors of prime goods movement travel and activity. The proposed survey is to be conducted at certain key geographic gateways (barriers) on the

State Highway System (e.g., I-5 Grapevine Pass, I-10 Beaumont Pass, and I-15 Cajon Pass) on high freight volume corridors that also constrain the free flow of goods. Because these locations constrain travel flow from one region to another, they provide good locations to survey large trucks to obtain origination and destination information to better understand how freight is moved.

III – Objective

To capture a more accurate picture of how freight is moved on these key corridors, in order to develop projects to improve the efficiency of the goods movement system.

IV – Background

There is interest by the Department to find ways to improve the flow of goods in the main corridors in California. However, there is currently a lack of information available to assist transportation planners in addressing goods movement and its impacts, including congestion, air and noise pollution, economic affects, and land use impacts. This includes significant shortages of information regarding volumes and travel patterns, including origins and destinations and routing.

V – Statement of Urgency and Benefits

California is experiencing a rapid growth of heavy truck traffic on the State Highway System. The rapid growth is due to a large population increase, (1/2 million, statewide, per year) and a rapid growth in international trade volumes through the State's seaports that is expected to more than triple from 1998 to 2020. This equates to a projected 79 percent growth in the volume of goods moved to and through California by 2020. The results of this project will benefit the following California transportation system users and partners:

- The nation's population which depends on shipments of goods on California's transportation system
- Trading partners who must ship to and through California
- Shippers and receivers of freight that utilize Southern California warehouses
- California-based businesses
- State, regional and local planners
- California Air Resources Board; regional air quality management districts
- California Highway Patrol
- Environmental Protection Agency
- Federal Highway Administration

Other potential benefits of this project include:

- Providing better information for prioritizing, selecting, and delivering transportation projects
- Improved State and non-State highway project delivery
- Improved air quality emission models and conformity analysis
- Enhanced data for inter-modal connectivity
- Enhancement of inter-Departmental coordination and data sharing

VI – Related Research

California Heavy Duty Truck Travel Survey, December 2001, Caltrans Division of Transportation System Information

VII – Deployment Potential

The final product will be a database that provides transportation planners with information on the origination/destination, routes traveled, and commodities transported. This information would be available to maintenance, traffic operations, planning, regional planning agencies and others to better identify goods movement projects that will improve overall system efficiency.

RPS: #PS-503

I – Problem Title

Consumer-Driven Functional Requirements for Travel Information

II – Research Problem Statement

The Department's travel information to the public via Internet is product-driven, with individuals independently investing and developing their own Internet sites, text pages, and maps. Market-driven research into consumer wants has been ignored since 1995-96, when most people still had not heard of the Internet. We don't know what kinds of people, looking for what kind of information for different kinds of trips, come or would come to the Department's Internet pages if the Department would invest in presenting travel information to the public on the Internet.

III – Objective

Develop consumer-based functional requirements the Department can use for presenting its travel information on the Department's internet web site. Public research on traveler information, specifically focus groups in urban and rural environments and addressing non-routine travel information needs. Consider excluding local everyday commute or regular trips where most people know those conditions/options and those trips generally do not involve state highway and intercity rail. Specifically ask if people want 12 or more web sites and maps with different icons and layouts when they come to Caltrans, or if they expect a standard format.

Do people use Caltrans Internet to find comprehensive information on buses, trains, bicycle paths that are owned and operated by other agencies? Or would they accept links to responsible regional agency 511 web sites, e.g., 511.org or Sacregion511.org for comprehensive multimodal information? Or links to private companies that combine and publish information from numerous agencies and across county and state borders, e.g., MetroNetworks and Traffic.com?

Do people potentially using Caltrans web and telephone services expect real-time highway or freeway information on traffic congestion? Do they prefer the congested to be presented in colored dots at detection stations or as colored highway segments? Red-Yellow-Green, five colors, or how many colors? Are ADA considerations important, such as colorblindness? Or multi-lingual presentation? Do they want 'artistic' graphic maps or 'GIS' representational maps? How should the maps be presented: in little squares like a paper map or vectors where consumers can move to higher – more detailed - resolutions? Do they prefer tables of traffic speeds stated in tenths of miles per hour (e.g., 42.7 mph)? How about "real-time" incident and routine lane closures, whether or not they create significant travel delay for the consumer? Or lane closures that may be

planned during the next several hours/days? Or chain controls, emergency messages (as displayed on changeable message signs), travel time estimates (either as displayed on changeable message signs in urban areas, or otherwise calculated) and roadway weather conditions including fog visibility? Do they want to view closed circuit television cameras and make their own assessment of traffic conditions for planning trips? What about location and availability of parking spaces at Park and Ride Lots? Or locations of Scenic or Safety Roadside Rest pull-offs? Or High Occupancy Vehicle lanes? State Highway-approved bicycle paths and routes?

This research promotes the Department goal for Flexibility: Consumers can learn where incidents and closures will affect their trip, know to avoid congested and emergency situations, and select options for changing the route, time, and travel mode for their trip.

IV – Background

Consumer research was last done under the Transportation Demand Management marketing program in 1995.

V - Statement of Urgency and Benefits,

Proper development of Departmental services to the public depends upon knowing consumer-driven functional requirements. Higher quality traveler information on the Department's internet pages will drive commercial/media to improve their products/services, resulting in overall better information to more people.

VI – Related Research

1995 'Smart-Traveler' focus groups (www.dot.ca.gov/caltrans511/biblio/index.htm)

MTC 'TravInfo/511 focus groups

National 511 Coalition focus groups/statistical survey (www.deploy511.org)

VII - Deployment Potential

A standard Departmental Travel Information map prototype has been developed and is awaiting district feeds for traffic speeds, lane closures, CMS signs, weather and fog visibility, cctv, chain controls. Consumer-driven functional requirements will improve the prototype's content, features, and management acceptance.

RPS: #PS-504

I - Problem Title

Removing Barriers for Seniors at Transit Stops and Stations and the Potential for Transit Ridership Growth

II - Research Problem Statement

Transit operators as well as transportation planners and engineers need to have a better understanding of what type of improvements at transit stops and stations do actually result in increased safety and accessibility as perceived by seniors. For most seniors transit is not considered a practical travel option, driving is their major means of getting around. If that option fails due to disabilities they are forced to stay at home, losing their independence and lifestyle options and becoming increasingly isolated and depressed.

Transit could provide a feasible mobility alternative if facility designs were safer and more accessible for seniors.

III – Objective

The objective is to increase mobility options for seniors, in particular for those with disabilities. In cooperation with senior groups and selected transit operators, this research aims to identify physical barriers at transit stops and stations preventing many older persons from using transit. Given that transit services and mobility options for seniors in urban, suburban, and rural areas vary significantly, those differences in tackling stops and station design problems should be addressed. A crucial component of the study will be to test the effectiveness of selected improvements by measuring changes in ridership once upgrades are in place. The research will assist the Department in meeting its flexibility goal - to make transit a more practical travel option.

IV – Background

Nearly four million people over age 65 live in California today. This number is expected to more than double over the next several decades¹. As the population ages we can expect enormous changes that will affect California's transportation system requirements as older people often have distinct and different mobility needs and travel behavior patterns than younger population groups.

The Department has recognized these changes by funding projects that address the changing travel needs of seniors and projects that promote walking as a universally accessible mode of transportation. For example: The Division of Mass Transportation is chairing the California Long-Range Strategic Plan on Aging Transportation Task Team; the Division of Research and Innovation is currently funding senior transit accessibility projects, none of them, however, with a focus on physical safety and access barriers; and the Division of Transportation Planning is funding walkable communities workshops working with local community leaders to make the transportation system more pedestrian-friendly.

This research is proposed and supported by the California Long-Range Strategic Plan on Aging Transportation Task Team charged with implementing the Strategic Plan recommendations. It addresses one of the Plan's recommendations, 'to improve access to transit ' as strategy to 'to support pedestrian-oriented facilities and services'².

V – Statement of Urgency and Benefits

With a rapidly growing senior population in California, there is an urgent need to better understand what type of design improvements at transit stops and stations work for seniors who are no longer willing or able to drive.

VI – Related Research

The following research is scheduled for funding in this fiscal year by the Division of Research and Innovation (selected and managed by the Mineta Transportation Institute):

¹ California Health and Human Services Agency, California's Strategic Plan for an Aging Population: Getting California Ready for the Baby Boomers, October 2003

² California Health and Human Services Agency, California's Strategic Plan for an Aging Population: Getting California Ready for the Baby Boomers, October 2003

- Barriers to Using Fixed-Route Transit for Older Adults, San Jose State and University of Buffalo
- The Elderly and Public Transit: Minimizing Barriers and Maximizing Service, UC Berkeley PATH and San Jose State University
- Evaluating Strategies for Increasing Senior Ridership on Regular Public Transit, San Jose State University

VII – Deployment Potential

The research will provide transit operators with a better understanding of what types of physical improvements would make it easier and more attractive for seniors and persons with disabilities to use transit. The success of such improvements will be measured in ridership changes. The potential to achieve ridership growth could be an incentive for transit operators to participate in this research.

RPS: #PS-505

I – Problem Title

Policy Analysis and Planning for Hydrogen Energy and Distributed Power

II – Research Problem Statement

As a major state agency that operates a large vehicle fleet and that has large and diverse electrical and thermal power needs, Caltrans has an abiding interest in maintaining its operations in a low cost and environmentally responsible manner. Furthermore, Caltrans may be asked by the Governor to play an important role in the California Hydrogen Highway Network initiative. Understanding the potential costs, benefits, and challenges associated with participating in hydrogen infrastructure and distributed power generation projects and programs -- in a way that is in line with Caltrans' internal goals -- is therefore important to the agency's ongoing operations. This solicitation is intended to produce research and analysis to help Caltrans understand the issues and opportunities associated with participating in hydrogen energy and distributed power generation projects in its vehicle fleet and maintenance operations.

III – Objective

This research would help to position Caltrans to participate in additional clean vehicle demonstration and implementation activities, potentially participate in hydrogen infrastructure projects and programs, and further its efforts to explore distributed generation of electrical power (e.g., at its maintenance facilities). The research would explore promising options for hydrogen energy/fuel and distributed power generation systems within Caltrans operations, analyze California and national policy and incentive programs for hydrogen and distributed power systems, and examine the financial impacts of potential system deployments on Caltrans operations.

This research would contribute to the Departmental goal of performance. The performance goal would be advanced by: 1) improving the environmental and potentially the economic performance of Caltrans operations, and 2) assisting the State in improving the environmental and energy performance of the transportation system by advancing the overall development and implementation of clean vehicles and energy technologies.

This research would also further the California Transportation Plan (CTP) goals of enhancing the environment, supporting the State's economy, and promoting community values.

IV – Background

California experiences relatively high commercial rates for electrical power and vehicle fuel. The State also has significant air quality problems, particularly in the Central Valley and South Coast regions. These conditions have produced considerable interest in alternative, cleaner-burning transportation fuels and cleaner and more cost-effective means of providing electrical power and other energy services to buildings. They also have produced environmental regulations to restrict vehicle emissions that have and will continue to impact Caltrans operations.

Hydrogen offers perhaps the most compelling long-term fuel for automotive applications as it can simultaneously address concerns related to air pollution, greenhouse gases, petroleum dependency, and energy security. Distributed power generation (DG) is an emerging paradigm of electricity production that is relevant to hydrogen use. DG can reduce needs for large central power plants and distribution networks and can offer economic and environmental benefits particularly when waste heat from power production is captured and re-used.

V – Statement of Urgency and Benefits

On April 20, 2004 Gov. Schwarzenegger announced the California Hydrogen Highway Network by Executive Order (S-7-04). Caltrans employees have been among many government, industry, and academic contributors to the Topic Teams that have been formed around this initiative for the purpose of gathering information and identifying knowledge gaps. The Topic Teams have been charged with developing various reports and providing them to an executive committee for the development of a "hydrogen blueprint plan" by January 1, 2005. This report is likely to have potential impacts on Caltrans operations, particularly in the areas of vehicle fleet management, buildings and facilities, and environmental analysis and compliance. This research would assist Caltrans in complying with this new initiative in a way that is compatible with Caltrans operations and in line with its organizational goals and the CTP.

VI – Related Research

- PATH Task Order 5107: "Clean Hydrogen for Transportation Applications" – Inst. of Transportation Studies, UC Davis
- PATH Task Order 5112: "An Integrated Hydrogen/Intelligent Transportation Systems (ITS) Evaluation for the California Department of Transportation" – Inst. of Transportation Studies, UC Berkeley

VII – Deployment Potential

Hydrogen vehicle and other advanced power technologies are highly deployable but some currently face remaining cost, technical, and regulatory (i.e., codes and standards) issues. Caltrans research has the potential to positively impact the commercial potential of hydrogen-related and other clean and efficient technologies.

RPS: #TS-506

I – Problem Title

Deliver a Set of Tools to Resolving Bad Inductive Loops and Correcting Bad Data

II – Research Problem Statement

Inductive loop detection remains the least reliable component, which is common to many field elements. No suitable alternative detection technology has yet been found.

Inductive detection systems are subject to frequent malfunction and failures and are difficult and costly to maintain. The current methods/tools for identifying and fixing bad loops is time consuming, consequently loops are failing at a faster rate than they can be repaired, which is resulting in suspect data quality and putting the performance of applications that depend on inductive loop data at risk.

III – Objective

Several ideas are proposed that are worthy of being evaluated to help mitigate the bad inductive loop problems. This project is to evaluate the effectiveness of possible solutions and to adapt them for immediate use by Caltrans' District personnel. These ideas are to be evaluated and adapted for use by Caltrans District personnel:

- 1 A way to analyze reported detector data to identify defective, malfunctioning and miss-assigned detectors including a process for track resolution of the problems.
- 2 A reliable method or easy to use tool for confirming the accuracy of the volume speed and occupancy measurements of freeway inductive loop detector stations.
- 3 Identify the best equipment to use for pinpointing the exact location of electrical problems in failed inductive detection loops.
- 4 Define criterion for when “bad loops” can be repaired by replacing the conventional detection cards with new “smart” detection cards.
- 5 Qualify an easy to use “data cleansing” tool that can automatically compensate for faulty detector data and restore data to a high level of statistical accuracy.

IV – Background

PeMS shows about one third of the loop stations not reporting and half of the remaining loops reporting questionable data.

V – Statement of Urgency and Benefits

Maintaining detectors has been a growing issue and the lack of reliable data is limiting the effectiveness of many applications (such as Ramp Metering and Traveler Information) and traffic management/measurement efforts overall.

Improved traffic data, reduced inefficiency in loop-detector repair

VI – Related Research

Not provided.

VII – Deployment Potential

All of the suggested solutions would have immediate use in the field.

RPS: #TS-508**I – Problem Title**

Field Element Effectiveness

II – Research Problem Statement

It is unknown how effective Transportation Management System field elements (CMS, HAR, etc.) are in modifying motorist travel plans and behavior. We do not have enough data regarding 'the effect on travelers and therefore congestion' to make good decisions regarding prioritizing ITS field element investments (installation and use.)

III – Objective

Determine reliable performance measures and determine if real benefits are derived from the use of the transportation management system field elements. Research would be in four areas:

1. Message clarity-Are motorist understanding the message as it was intended?
2. Message reliability-Are the message delivery systems reliable?
3. Motorist behavior-Are motorist adapting travel plans as intended?
4. Performance measures-Are tools available to measure these outcomes, if not what tools need to be implemented or developed?

IV – Background

Many hundreds of field elements have been installed without any methods to evaluate their effectiveness. Reliable performance measures are not available, nor has research been conducted to determine a baseline to serve as a guide for the implementation of improvement strategies.

V – Statement of Urgency and Benefits

This problem is urgent under the current competitive budget situation. The benefit of addressing the problem: Responsible performance measurement data and management decisions become possible. State budget issues will come to bear on programs that cannot demonstrate viable benefits through accepted performance measures. TMS strategies should achieve their promised potential, now, and this needs to be done through improvements based on well-founded data.

VI – Related Research

TMC Performance Measurement (Problem requested this year Mobility TAP Problem #2004Mob.4 – #TS-511)

VII – Deployment Potential

6 months after final recommendations are delivered.

RPS: #TS-509**I – Problem Title**

Evaluation of Portable Automated Data Collection Technologies

II – Research Problem Statement

A portable and economical data collection system is needed that could be used to automate data collection that is currently done manually. The Department has invested heavily in permanent loop detector stations. These detector stations provide an automated process by which valuable traffic volume and speed data can be obtained at many locations along State highways. However, there are many situations in which manual traffic data collection is still necessary. These situations include mainline, ramp and connector locations at which permanent count stations have not been installed or have been installed but are not operable, intersections for which turning movement data is needed, and construction work zones. Manual data collection is labor-intensive and sometimes can be accomplished only when staff resources become available. Manual data collection can also be relatively expensive since traffic studies frequently require commute period data for which staff overtime is necessary. In some cases, manual data collection can also expose staff to moving traffic.

III – Objective

The objective of this research effort would be to inventory and evaluate currently available portable vehicle detection technologies, which can be used to automate data collection on an ad hoc basis. The intent would be to use the device at any location as needed.

The scope of this research would include:

- Identifying currently available, economically viable portable vehicle detection technologies;
- Testing these technologies under a range of common applications including:
- Multilane detection for volume and speed determination to be used for a wide range of activities including traffic studies, micro simulation analyses, congestion monitoring, traffic census, traffic management and travel condition reporting;
- Temporary signal installations;
- Vehicle classifications for traffic and truck studies;
- Intersection turning movements.
- Consulting with Caltrans Traffic Operations district staff to establish appropriate performance measures for data accuracy, component reliability, and adverse operating conditions (fog, rain, freezing temperatures, etc.) under each common application.
- Evaluating how each technology performs under the associated application and recommending “suitable” technologies for each of the common applications.
- Providing information on typical installation issues by common application type such as initial cost for each technology, maintenance cost for each technology, installation and removal cost for each technology, deployment issues (e.g. set-up and take-down time, ease of set-up/take-down, calibration time/effort, other equipment needed for set-up, personnel exposure to traffic during set-up/take-down), power needs (e.g. electrical power, solar power, battery power/life), communication needs, portability (e.g. “device” size), and security.

IV – Background

Considerable manpower is expended manually collecting traffic data for various purposes. Manual traffic counts are frequently conducted during weekday commute

periods that typically require costly staff overtime. Historically, manual counts have been necessary because either permanent count stations were not available or intersection turning movement data was needed.

V – Statement of Urgency and Benefits

A successful outcome benefit of this project would allow the Department to reduce costs for collecting some types of traffic data currently collected manually. In some cases, it would also reduce staff exposure to moving traffic.

VI – Related Research

Unknown.

VII – Deployment Potential

Any findings or recommendations from this project could be deployed as soon as funding is available.

RPS: #TS-513

I – Problem Title

Optimal use of CMS for Displaying Travel Times

II – Research Problem Statement

The State of California does not display travel times to the traveling public using the existing CMS system. There is no supporting documentation in Caltrans on the effectiveness and cost/benefit of using the CMS for this function. However, there is a trend in the industry to display travel times on CMSs and there is increasing pressure from Federal Highway Administration to implement this strategy.

III – Objective

The objective of this study is to provide an analytical approach and solutions to the following concerns:

- Identify most effective corridors to display travel times
- Evaluate current systems capabilities of providing travel times (automatically)
- Determine appropriate operational procedures for displaying travel times
- Obtain and evaluate public feedback on travel times (surveys)

IV – Background

- Statewide network of over 500 permanently CMS
- 3 different CMS models - the 500, 510 and 520, all are capable of displaying travel time messages.
- David Lively headed a taskforce in 2003 to pursue travel time displays in select Districts throughout the state. This effort was abandoned due to legal concerns over a patent to use the travel time algorithm.
- PATH – Travel Time And Alternate Route On CMS, October 24, 2002 – Chao Chen, Karl Petty, PeMS Development Group, UC Berkeley
- Travel Times On Changeable Message Signs: Pilot Project – Chao Chen, David Lively, Kane Wong, Paul King, Alan Chow

- July 16, 2004 FHWA Memo titled “Information and Action: Dynamic Message Sign (DMS) Recommended Practice and Guidance

V – Statement of Urgency and Benefits

The primary benefit of evaluating our current CMS system is to obtain an objective yet public opinionated approach in determining the effectiveness of the system. If deemed an appropriate use of our system and implemented correctly, displaying estimated travel times could allow motorists to choose an alternate route or possibly encourage a modal shift of transportation.

VI – Related Research

- FHWA TMC Pooled-Fund Study, 2002

VII – Deployment Potential

- Deployment can begin immediately
- Implementation is contingent upon resolution of the legal issue

RPS: #TS-515

I – Problem Title

Optimal Sensor Requirements for Traffic Management and Traveler Information Applications

II – Research Problem Statement

Sensors continue to be deployed within the freeway right of way without a definitive analysis of the data requirements of the interrelated Traffic Management and Traveler Information applications. The one-time and continuing costs of sensor and communication infrastructure installation and maintenance continues to increase without knowing whether the associated benefits are realized.

III – Objective

To analyze each traffic management and traveler information application to determine:

- Minimum data requirements in urban, midsize and rural districts for each application type to work.
- Optimum data requirements in urban, midsize and rural districts for each application type to work.
- Application types to include at minimum: manual traffic surveillance, automated traffic surveillance algorithms, manual ramp metering control, automated ramp meter control algorithms, traveler information.
- Data requirements to address at minimum: sensor placement locations, distance between sensors, data frequency, data aggregation.
- Cost/benefit analysis between current sensor deployment strategies and the results of this effort’s minimum and optimum data requirement analysis.
- Analysis proven through simulation modeling and then validating the model is accurate in a real-world corridor test.

- Capitalization of previous research efforts (e.g. Advanced Traffic Management simulator at the University of California – Irvine, other previously modeled corridors).

IV – Background

Budget Change Proposals (BCP's) to support the continuing costs of sensor maintenance and associated communication infrastructure are not being approved. The Department of Finance continues to request a detailed cost/benefit analysis to justify increased funding levels and Caltrans does not have sufficient information. Additionally, there is no definitive analysis to demonstrate that Caltrans is putting too many, just enough, and/or too few sensors to satisfy the present and near-future Traffic Management and Traveler Information applications.

Last year's research cycle awarded a contract (TS03 – PATH RFP 2004) for a Data Sensitivity Analysis to investigate how data margins of error that are independent of technology affects ramp metering and detecting the onset of congestion. TS03 research does not overlap the scope of this proposals effort, however can contribute to this effort with proper coordination.

V – Statement of Urgency and Benefits

BCP's for the continuing costs of sensor deployment will more than likely not be funded and Caltrans will have to continue to redirect funds.

Benefit potential: Appropriately conducted research should help obtain BCP approval for increased funding, and may also augment Caltrans' sensor design practices to maximize the cost and benefit for their intended applications.

VI – Related Research

There are numerous other prior related research efforts that may be capitalized upon (e.g. previously other modeled corridors, ATMS simulator at UCI). TS03 research does not overlap the scope of this proposals effort, however can contribute to this effort with proper coordination. Responses to this Request for Proposal should at minimum identify prior research that was considered and why it was not appropriate for this effort.

VII – Deployment Potential

Once appropriate, conclusive research is completed it can be immediately used to assist BCP justification. Additionally if the analysis finds that existing sensor design practices do not maximize the cost and benefit for their intended applications, then design guidelines can be updated within 6 months to quickly take advantage of the findings.

RPS: #TS-516

I – Problem Title

Bicycle Detection and Operational Concept at Signalized Intersections

II – Research Problem Statement

With the growing numbers of bicyclist everyday, the bicycle detection at signalized intersections is becoming one of the major operations and maintenance issues. State, Counties and Cities are providing bike lanes wherever applicable, including near the

intersections, however, there is no guideline on installing bicycle detection or adjusting the timing at these locations. A robust and reliable bicycle detection methodology needs to be developed.

III – Objective

- 1) Identify the most effective bicycle detection technologies.
- 2) Identify the safest and the most effective methodologies to service the bicyclists at signalized intersections.
- 3) Demonstrate its functionality with the existing 2070TSCP program.
- 4) Evaluate its performance and its capabilities at most traveled bicycle sites.
- 5) Develop operational procedures, such as the location of the detection and appropriate timing for signal operations and maintenance.
- 6) Develop operational guidelines for bicyclists at signalized intersections.
- 7) The final product shall function in the type 332 cabinet and shall also be compatible with the existing state standard Model 2070 controller and its intersection program, TSCP.
- 8) Determine and measure the benefits of the system for all stakeholders.

IV – Background

Currently, wherever applicable, bicycle detection is installed using the type "D" inductive loop. The type "D" loop is very expensive to install and hard to maintain. There is however, video detection and other detection technologies that could provide more accurate and reliable detection for the bicyclists. There is also operational concern on where to install the bicycle detection and how to service the bicyclists and adjust the timing needed for them to cross the intersection safely.

V – Statement of Urgency and Benefits

California Vehicle Code states that bicycles are subject to the same rule of the road as other vehicles. On May 20, 2004, Caltrans adopted the MUTCD 2003. The MUTCD 2003 suggests that signal timing shall be reviewed and adjusted for bicyclists accordingly. Cities and Counties follow the State policies and guidelines for the installation and operation of the bicycle detection. Therefore, Caltrans needs to provide an operational policy and guidelines for the installation of bicycle detection. Caltrans will also need to provide guidelines on how to service the bicyclists at the signalized intersection.

VI – Related Research

Unknown

VII – Deployment Potential

Immediately

RPS: #TS-519

I – Problem Title

Weave Analysis Evaluation and Refinement

II – Research Problem Statement

The Caltrans Highway Design Manual allows for the use of two weave analysis methodologies, the Leisch Method and the Level of Service D Method. These analysis tools, however, produce inconsistent and sometimes incompatible results.

Weave areas are freeway sub-segments where the facility is typically the most stressed due to traffic speed differentials and lane changing maneuvers. The length of a weave segment is a critical design decision. When a weave segment is improperly analyzed, acceptable design alternatives may be excluded and/or a new facility may fail sooner than anticipated.

In the District 5 Traffic Operations' experience, available weave analysis tools (Leisch method, LOS D method, and HCM) provide a significant degree of output variation depending on the conditions for which the tool is applied. This inconsistent application of each tool results in analysis that cannot be relied upon without further guidance about what tools should be employed under a given condition.

III – Objective

This research effort would result in a report that documents under what conditions the “best available” tools are most effective. The report would also provide guidance for the proper use of these weave analysis tools and under what range of conditions each tool is most appropriately applied.

The effort would entail performing a literature search, field-testing methodologies as needed, and documenting the findings in a report. An addendum should be prepared as part of the report that can serve as a technical guideline for application of these tools. The information can then be used to update the weave analysis guidance provided in Chapter 500 (Section 504.7) of the Highway Design Manual.

IV – Background

Weave analysis methodologies assess a number of critical factors to provide Level of Service (LOS) and/or expected operating speed outputs. These factors (weaving volumes, through volume, type and number of lanes, and weaving length) can vary significantly by analysis year and design alternative.

The weave analysis tools recommended for use in the Caltrans Highway Design Manual, the Leisch Method and the Level of Service D Method, were initially developed in the 1960's. Since then traffic trends have changed, vehicle performance has improved tremendously, freeway segments have been upgraded to newer standards, and driver behavior has changed.

The Highway Capacity Manual (HCM) 2000 provides another commonly used weave analysis method that is not endorsed for Caltrans used due to the fact that the output can produce inaccurate results under certain conditions.

V – Statement of Urgency and Benefits

Benefit: Consistent and accurate weave analysis results. The use of accurate tools to assess and recommend design solutions for weave segments is of critical importance, both for Caltrans initiated projects and for developer-funded interchange projects. A successful outcome of this project would allow the Department to ensure that critical interchanges and freeway segments are accurately designed where weaving maneuvers will be involved.

VI – Related Research

There is a good deal of published research relating to weave analysis. A portion of this effort would be to synthesize applicable research findings into a guide to be used by traffic operations and design personnel.

VII – Deployment Potential

Any findings or recommendations from this project could be deployed as soon as the research effort is complete.

RPS: #TS-520

I – Problem Title:

Animal Warning System Effectiveness

II – Research Problem:

Every year vehicular collisions with wildlife cause a reported 211 human fatalities and tens of thousands of injuries nationwide. This results in an estimated cost to our society of over 1 billion annually.

III – Objective:

To determine if animal warning systems reduce collisions and are effective at creating a safer highway via a pilot study near Mc Donald Creek on Highway 101 in Humboldt County. Research will be designed to study the effectiveness of animal warning systems to detect wildlife on the roadside and to measure driver response.

IV – Background:

District 1 is interested in finding a solution to the animal-vehicle collision problem. The Department of Fish and Game and Redwood National and State Parks are interested particularly in partnering to find a solution to reduce elk-vehicle collisions. After a review of the various mitigation methods and several working group meetings, it was decided the best option may be to give drivers a warning with dynamic signing: either text messaging or flashing beacons triggered by either infrared cameras or beam break detectors.

V – Statement of Urgency and Benefits:

To date, little independent peer-reviewed research on the systems is available. Data obtained as a result of this study could be used statewide to determine how drivers will respond to dynamic signing, as well as how animals behave when approaching the highway. This qualitative information could be very valuable in developing strategies for reducing animal-vehicle collisions and improving motorist safety. Potential value includes use with species such as deer, antelope, bear and mountain lion. Elk would be ideal for the pilot study because the resident elk population is increasing and expanding throughout the Route 101 corridor in Humboldt and Del Norte Counties and the McDonald Creek site provides an opportunity for a cooperative research effort. During 1992-2001, there were 34 collisions involving animals along Route 101 in Humboldt County from post-mile T 114.2 to post-mile 116.0. The cost of these

collisions is estimated to be about \$2,043,400 (based on an average cost of \$60,100 per collision). A 25% reduction in collisions involving animals at this location would provide a savings benefit of \$540,900 over a ten-year period. The total cost of the project is \$525,000. Therefore, the benefits to cost ratio for a 25% reduction in collisions involving animals along this section of roadway would be 1 to 1. Note that there could be additional benefits if successful systems are applied in areas of concentrated animal vehicle collisions statewide.

VI –Related Research:

- Kinley, Trevor A. et al, Use of Infrared Camera Video Footage from a Wildlife Protection System to Assess Collision-Risk Behavior by Deer in Kootenay National Park, British Columbia. March 2003. Prepared for: Graham Grilfillan Insurance Corporation of British Columbia Kamloops, BC.
- Wyoming Cooperative Fish and Wildlife Research Unit. University of Wyoming. Evaluation of the FLASH (Flashing Light Animal Sensing Host) System in Nugget Canyon, Wyoming. 07/01.

VII – Deployment Potential:

Successful systems may be applied in areas of concentrated animal vehicle collisions statewide.

RPS: #XB-501

I – Problem Title

Cooperative Intersection Collision Avoidance (CICA)

II – Research Problem Statement

In the year 2000, intersection related crashes in California resulted in 17,705 injuries and 172 fatalities, and nationwide, intersection crashes that year resulted in 1.5 million injuries and 9000 fatalities. According to Bauer and Harwood³, using data supplied by Caltrans, countermeasures which address the 15% of most hazardous intersections would address 36% of total crashes; using cost and effectiveness assumptions by Ferlis⁴, in California a 50% effective CICA system could save California in excess of \$375M each year. The problem is that the hazard and associated costs of intersection related collisions are unacceptably high, particularly for the 15% of the most hazardous signalized intersections.

III – Objective

³ Bauer, K.M., and Harwood, D.W. *Statistical Models of At-Grade Intersection Accidents*. Report FHWA-RD-96-125. FHWA, U.S. Department of Transportation, 1996.

⁴ Ferlis, Robert A. Infrastructure Collision-Avoidance Concept for Straight-Crossing-Path Crashes at Signalized Intersections. Transportation Research Record, No. 1800, 2002, pp 85 - 91.

To achieve deployment of intersection collision avoidance systems that can save lives and prevent injuries at 15% of the most hazardous signalized intersections nationally, with in-vehicle support in 50% of the vehicle fleet, by 2015.

This aligns well with the US DOT CICA initiative⁵, which builds upon work already invested by California and other states of the “Infrastructure Consortium”, part of the USDOT’s Intelligent Vehicle Initiative. It also aligns with the emerging “revolution” in Vehicle Infrastructure Integration (VII), which has significant US DOT, automobile manufacturer, AASHTO and Caltrans support to leverage off the FCC allocation of Dedicated Short Range Communication (DSRC) spectrum⁶ to provide the enabling communication capability necessary for CICA.

IV – Background

The CICA initiative is national in scope, with significant aforementioned leveraging and benefits to accrue to Caltrans, which has in the past has provided a significant technical and conceptual role to the underlying technologies and prior efforts (Intersection Decision Support, IDS⁷).

Also, according to the US DOT³:

Intelligent intersection systems can help drivers avoid crashes at intersections. They can be vehicle-based, infrastructure-only or infrastructure-vehicle cooperative. Vehicle-based systems incorporate sensors, processors and driver interfaces within each vehicle. Infrastructure-only systems rely on roadside sensors and processors to detect vehicles and identify hazards and then utilize signals or other methods to communicate warnings of potential crashes to motorists. Infrastructure-only deployments also require data processing techniques, a necessary evolutionary step towards deployment of subsequent cooperative systems enabled by Vehicle Infrastructure Integration (VII). Infrastructure-vehicle cooperative systems will utilize roadside detection and processing systems as developed and refined by infrastructure-only efforts, and will also have a communications system, like Dedicated Short Range Communications (DSRC), to communicate warnings and data directly to drivers in vehicles equipped to receive and display the warnings.

V – Statement of Urgency and Benefits

This research is urgent because the CICA initiative, a five year program, is expected to begin in earnest in FY05 (beginning September, 2004). Caltrans has a significant role by virtue of their leadership of predecessor research conducted under IDS and have been asked by US DOT to participate in CICA, beginning at the initial stages.

VI – Related Research

See references below.

VII – Deployment Potential

The CICA initiative is aimed at deployment, and is considered by industry, State DOT officials (from the AASHTO VII working group) and academia to be perhaps the most

⁵ See < <http://www.its.dot.gov/initiatives/initiative2.htm>>.

⁶ See < <http://www.learmstrong.com/DSRC/DSRCHomeset.htm>>.

⁷ < <http://www.path.berkeley.edu/PATH/Research/Featured/032703/IDSforWeb.html>>.

valuable and deployable of the VII-related initiatives. Never before have infrastructure owners/operators, vehicle manufacturers and the Federal Government aligned so carefully in a significant safety initiative, which in turn needs these participants to deploy (relatively inexpensive) wireless systems that “talk and listen” to the infrastructure to achieve a potential quantum leap in intersection safety.

How will this be done? The CICA will pursue an optimized combination of autonomous-vehicle, autonomous-infrastructure and cooperative communication systems that potentially addresses the full set of intersection crash problems, culminating in a series of coordinated field operational tests. The field operational tests will also help achieve a solid understanding of safety benefits and user acceptance. In the end, and according to US DOT, “commercially deployable intersection collision avoidance systems will be developed.”

Therefore, the objective statement above is not a solely a Caltrans enterprise; rather, it is combined objective with other organizations to research and deploy a national interoperable intersection collision avoidance system, with significant – and potentially revolutionary – benefits to the public. Caltrans investments (at an 80/20 level) and technical contributions will be leveraged, and the aforementioned substantial cost benefits could be recovered to the State.

RPS: #XB-502

I – Problem Title

<Phase 1 of the Virtual Weigh and Compliance Station Development Program>
“Virtual Weigh and Compliance Station Test-bed”

II – Research Problem Statement

Due to the sharp rise in both commercial and passenger vehicular traffic coupled with a static staffing level equivalent to the late 1960s, the California Highway Patrol (CHP) is experiencing difficulty with deployment of adequate numbers of commercial officers for efficient CV enforcement operations. One possible solution to this problem is development of technologies for real time screening of high risk motor carriers of freight for spot inspection and enforcement. A first step is to test and evaluate current technologies (virtual weigh station, gamma ray scanning, vehicle ID) to determine how they can be modified, developed and incorporated into CHP and Caltrans enforcement and compliance operations. The end result of effective research and testing should lead to the development and deployment of automated CV enforcement capabilities.

III – Objective

Set up one and possibly multiple locations for testing and developing the various technologies that might be incorporated into the Virtual Weigh and Compliance Station (VWCS) concept. The development and deployment of any one of the technologies will lead to increased compliance with the following benefits:

- Weigh-in-motion – Facility Preservation and Safety Improvement - Detect overweight vehicles for screening and enforcement for pavement and structures protection
- Brake screening – Safety – Screen for bad brakes to improve safety
- Emissions sensing (ID gross polluters) – Environment – Monitor/improve air quality

- Sensing expired inspection tags – Safety – Increase safety compliance
- Gamma ray detectors – Security – Increase homeland security
- Vehicle identification – Cross-cutting enabling technology - Allows tracking of non-compliant vehicles facilitating enforcement

IV – Background

This project is part of Phase 1 of the Virtual Weigh and Compliance Station development program along with the creation of the feasibility study report (FSR), business case, and program plan to deploy VWCS technologies. The Virtual Weigh and Compliance Station development program is made of a number of different projects and activities that are broken down both functionally and along timelines based on each activity's institutional and technical complexity.

The long-term objective is to develop an automated commercial vehicle enforcement system for truck size and weight (i.e., similar to red light and automated speed enforcement). Intermediate objectives include developing technologies to screen trucks to perform real-time CV enforcement – both mobile and at fixed CV enforcement facilities (e.g., weigh stations). The near-term efforts include expanding and automating the statewide weigh-in-motion system to provide better data collection capabilities around the major ports, improving the access and usability of the WIM database, and performing the research and investigation necessary to build the business case and create a viable framework leading to automated enforcement. The VWCS Test-bed is a near-term effort to help in planning and decision-making in support of technology integration and deployment.

V – Statement of Urgency and Benefits

The program to develop virtual, remote, or roadside based systems consists of a number of phases with several activities within each phase. Delaying any of the projects or activities, especially in the early stages, means that the whole program and the deployment of the systems along with the concomitant inability to realize the full safety, economic, environmental, mobility, and facilities preservation benefits are also delayed.

VI – Related Research

(Not provided)

VII – Deployment Potential

Testing and assessment of currently available technologies is the first step in the development and integration of those technologies into state highway operation and enforcement activities. The deployment potential of any given technology or system will depend on the technologies maturity, environment, and application as well as institutional and funding challenges.

RPS: #XB-503

I – Problem Title

Feasibility Study for the Use of Biodiesel in the Caltrans Fleet

II – Research Problem Statement

Petroleum displacement and clean air are important to Caltrans and the state of California, and biodiesel may be a good method for lowering Caltrans' use of petroleum diesel fuel as well as reducing certain diesel exhaust emissions. However, many factors must be considered and understood before Caltrans can adopt its use in its fleet of diesel fueled vehicles.

III – Objective

This research will help Caltrans understand the impact of a variety of factors surrounding the use of biodiesel fuel in its fleet including, but not limited to, the following: 1) biodiesel compatibility with a diverse fleet of engines and exhaust retrofits, 2) emissions benefits and/or disbenefits, 3) commercial availability and pricing of biodiesel for purchase, 4) specifications needed for purchase of biodiesel for use by Caltrans, 5) regional issues e.g., air quality, weather, etc., impacting the use of biodiesel by Caltrans, 6) optimum biodiesel blend ratio, 7) miscibility with other diesel fuels, 8) emissions and petroleum reduction calculations, and 9) regulations, including those of the Air Resources Board, as well as other legal considerations that may have bearing on the use of biodiesel in California. This research would include a literature search as well as a demonstration of biodiesel in selected Caltrans vehicles and locations.

This research can contribute to the departmental goal of *Productivity* by reducing petroleum use and/or exhaust emissions on the state highway system without impacting Caltrans ability to deliver projects or operate the state highway system. Also, this research could contribute to the California Transportation Plan goals of enhancing the environment, supporting the state's economy, and promoting community values.

IV – Background

Caltrans has a large and diverse fleet of diesel fueled vehicles operating throughout the state of California. In 2001 Caltrans began a fleet greening initiative to reduce, as practicable, all exhaust emissions, especially nitrogen oxides (NOx) and diesel particulate matter (PM). Caltrans partnered with state and local agencies to implement the best methods including ultra low sulfur diesel (ULSD) and diesel exhaust retrofit systems. Bio-diesel fuels were not implemented due to increased NOx emissions and questions of fleet compatibility. NOx is a precursor to ozone and many local areas in California are not in attainment to the National Ambient Air Quality Standards (NAAQS) for ozone and therefore in danger of losing federal dollars for future transportation projects. However, since biodiesel is composed of non-petroleum fuels as well as having certain lower diesel exhaust emissions, biodiesel may have a role in the Caltrans fleet to reduce petroleum use and exhaust emissions.

V – Statement of Urgency and Benefits

Biodiesel may play a role to help California reduce its dependency on imported petroleum as well as contribute to cleaner air. However, without this research Caltrans could not adopt biodiesel without incurring unacceptable risk to its fleet equipment, public safety, or air quality. A better understanding of the factors surrounding the potential use of biodiesel could provide the following: 1) a plan for a smooth introduction of biodiesel into Caltrans thus avoiding negative experiences, 2) identification of regions and vehicles within Caltrans jurisdiction able to benefit from the use of biodiesel and facilitate its procurement, and 3) a calculator to help Caltrans capture

the benefits/disbenefits to exhaust emissions and petroleum reduction for its use of biodiesel, if adopted.

VI – Related Research

“Biodiesel and Caltrans,” issue/fact sheet, August 2004, Caltrans Division of Equipment.

VII – Deployment Potential

Caltrans currently uses approximately six million gallons annually of bulk diesel fuel. National production is estimated at approximately 60 to 80 million gallons annually which could be doubled or tripled if needed within a year.

3. FUNDING RESTRICTIONS

The maximum limit on individual awards is \$600,000 total and \$300,000 in any one year. In the past, most PATH projects have been funded at levels between \$25,000 and \$100,000 annually. In addition, high-cost proposals have had a significantly lower probability of success in being selected than low-cost proposals. Private sector involvement is encouraged, though cost sharing may be required to be cost competitive. In all cases, funding requests must be justified relative to the research contribution and the effort required for each task. PATH and Caltrans reserve the right to modify proposed budgets.

3.1 Multi-Year Proposals

Multi-year proposals – up to a three-year maximum – are encouraged when warranted by the research, especially if Field Operational Tests are scheduled for the second or third years. However, multi-year proposals will be funded by fiscal-year increments and are subject to an annual review, by PATH and Caltrans, of project performance, results, and continued relevance to program goals. In exceptional cases, PATH and Caltrans reserve the right to redirect funding or scope as priorities change. PATH has established guidelines with respect to the following categories of funding:

3.2 Research Assistants

PATH will pay research assistant (Graduate Student Researcher) salaries up to the maximum permitted by each university. Current Caltrans policy is to deny requests for tuition reimbursement. However, Caltrans will pay for the appropriate in-state fee remission, up to the currently established rate per semester per GSR at University of California campuses.

3.3 Travel

Funding for conferences requires explicit justification, along with specification of the conferences to be attended. PATH will not pay for more than one trip per year per investigator unless there is a specific and strong justification. International trips are only granted in exceptional cases and must be justified in the proposal. There is no limit on travel required for the direct performance of the research when justified by the work.

Proposers should include travel costs for participation in the PATH Annual Research Meeting, a project kickoff meeting, a final project briefing, and any other key milestones that would warrant briefings for the project sponsors.

3.4 Equipment

Purchases over \$5000 must be itemized and justified relative to project objectives. All purchased equipment becomes the property of the California Department of Transportation.

4. FURTHER INFORMATION

For information on the PATH RFP and proposal process, contact Alan Lochhead (Tel: (510) 231-5614; e-mail alan@path.berkeley.edu). For information on specific topics or current and past PATH research projects: contact the PATH Program Leaders:

- Jim Misener, Transportation Safety Research program: (510) 231-9561 or (misener@path.berkeley.edu)
- Susan Shaheen, Policy and Behavioral Research program: (510) 642-5059 or (sashaheen@path.berkeley.edu)
- Alex Skabardonis, Traffic Operation Research program: (510) 231-9541 or (skabardonis@ce.berkeley.edu)
- Wei-Bin Zhang, Transit Operations Research program: (510) 231-9538 or (wbzhang@path.berkeley.edu)

Abstracts of current PATH projects can also be obtained on-line on the web (<http://www.path.berkeley.edu>).

5. PRE-PROPOSAL SUBMISSION AND FORMAT (STEP ONE)

Submitters should request access to the RFP website before December 20, 2004. The PATH Administrative Staff will not be available to assist submitters between December 20, 2004 and January 3, 2005.

The pre-proposal will consist of 3-4 pages, and will include a project plan summary, estimated budget and description of the research team. The pre-proposal should include the Research Problem Statement identification code (as provided in section 2 of this RFP) in the title.

Project Plan Summary

- Brief summary of the problem, and how proposed research would contribute to solving the problem;
- Method of approach to the problem;
- Anticipated deliverables;
- Preliminary schedule and milestones;
- Steps to implementation, including additional research phases (if required) and a preliminary timeline for the final product.

Estimated Budget

Each pre-proposal must include an estimated yearly and total budget including: proposed number and type of personnel and person-hours of effort and major equipment proposed for purchase.

Research Team

Describe previous experience and training in relevant areas of research (one – two paragraphs). When relevant, highlight the contribution of research collaborations (across disciplines and campuses or with the private sector) to the project. Brief curriculum vitae/resumes of the PI and key personnel may be included as attachments.

Submittal Procedure for Step One Proposals

Each pre-proposal must be made available in PDF format and submitted on-line at the PATH electronic Proposal Submittal and Review website at:

<http://www.path.berkeley.edu/RFP>

In order to file (upload) a PDF file of the pre-proposal on-line, Authors (Principal Investigators) must have a current User Profile. Authors may obtain a New User Profile from the PATH RFP System Administrator at the Web site:

<http://www.path.berkeley.edu/RFP>

For more information regarding PDF files, please visit the following Adobe Acrobat website at: <http://www.adobe.com/products/acrobat>

For assistance in producing PDF files, please check the following URL:

<http://www.pdf995.com/>

One of the following will occur within 30-60 days:

- (a) The proposer will receive an E-mail approving the pre-proposal with a request for a Full Proposal (step 2), or
- (b) The proposer will receive an E-mail declining the pre-proposal.

Caltrans and PATH will evaluate each pre-proposal on the basis of the following criteria:

- Responds well to problem statement
- Meets Caltrans goals and objectives
- Cost is reasonable
- Is likely to succeed (lead to deployment)

Sections 6, 8 and 9 relate to the format, evaluation and submission of the full proposals (step 2). Full proposals will only be requested for pre-proposals that were approved in step one.

6. FULL PROPOSAL FORMAT (STEP TWO)

Each full proposal, including the budget, must be made available in PDF format (not to exceed 15MegaBytes) and submitted on-line at the PATH electronic **Proposal Submittal and Review website** at: <http://www.path.berkeley.edu/RFP>

For more information regarding PDF files, please visit the following Adobe Acrobat website at: <http://www.adobe.com/products/acrobat>

Proposals should be written in sufficient depth to allow assessment of the contribution both to transportation practice and to the state-of-the-art in research. Although there is no minimum or maximum length, we expect that most proposals will fall in the range from 10-20 pages single-spaced (excluding appendix). We also expect that proposal length will reflect the magnitude of the project. Each proposal should be divided into ten sections as outlined below:

A. Summary

- i. One paragraph summary of the problem statement and significance of research contribution.
- ii. One or two paragraph summary of the research plan, deliverables, research contribution to solving specific transportation problems, and how the final research product can be implemented to solve California's transportation problems.

B. Background

- i. Separately review:
 - Related research in the problem area (literature search);
 - Complementary research completed or underway at PATH and other California transportation research programs or centers.
- ii. Problem statement
 - Describe the impact of the proposal on the existing transportation issue/problem/need.
 - Identify the anticipated customers/users.
 - Explain how this project will improve transportation system safety, efficiency or effectiveness
 - What are the consequences for Caltrans and its customers if the problem/opportunity is not addressed?
- iii. Proposed solution
 - State project scope, objectives, and motivation.
 - If the research project involves selection of a specific technology solution from among multiple alternative approaches, explain the reasoning behind that selection.
 - Describe the alternatives
 - Identify the alternative that best satisfies the objectives
 - Explain why the selected solution was picked over the other alternatives
- iv. Describe how the proposed research will complement existing PATH projects.
- v. Describe the outcome of this research in terms of next steps; will the outcome result in a product that is usable by the practitioner? If not, what further research or additional activities would be required to reach that point? Be as specific as possible. Caltrans is interested in applied research and results.

C. Methodology

Explain the proposed research methods in sufficient detail to enable evaluation of feasibility, originality and significance of the proposal. If appropriate to the content of the proposal, describe the current technology that is the subject of the proposal. For multiple-year projects, later year tasks need not be described in as much detail as the first year.

However, a detailed plan will be required in each subsequent year, in sufficient detail that PATH and Caltrans managers can evaluate reasonableness of progress, workload, and budget estimates.

D. Research Plan and Deliverables

Provide a research plan with specific milestones and deliverables. Deliverables should be described precisely and in depth, and should be clearly related to the methodology. If a Field Operational Test is planned, discuss how it will be performed, and identify an agency that will participate in the FOT.

Multi-partner proposals should clearly identify which party is responsible for each task.

Quarterly progress reports/meetings are required for all projects, regardless of the duration of the project, and every project must have a final report.

New requirements apply to software that is developed as deliverables under Caltrans-sponsored PATH projects. All such software must be provided in source code, with source code documentation (program level software design documentation, associated data files, data structures and algorithms necessary for a third party to be able to make code modifications) and software documentation (manuals, handbooks, libraries and software maintenance instructions). Proposers must ensure that they have budgeted adequate labor resources to meet these requirements, which exceed those normally encountered in academic research.

At the conclusion of the project, the P. I. will deliver a final report and present his/her results in a workshop forum, including a full explanation of the applied usefulness of the research. This may be done as a single-topic workshop or bundled with other related topics.

Also include in the proposal a list of tasks and a set of deliverables summarized in two separate tables. This will serve the purpose of setting up a web-based PATH quarterly report information page for your project, should your proposal be funded. (Please refer to <http://www.path.berkeley.edu/Quarterly> for more information regarding the web page for PATH technical quarterly reports.)

The tables must have the same formats as those in the examples shown below. Otherwise, the proposal will not be accepted.

List of tasks	Start date	End date
1. Literature survey	7/1/05	9/30/05
2. Problem formulation, methodology and solution	9/1/05	12/31/05
3. Implementation issues: hardware design, and coding of algorithms	12/1/5	3/15/06
4. System integration	3/1/06	6/30/06

List of deliverables	Date of completion
1. MATLAB subroutine algorithms	3/15/06
2. Circuit layout, system block diagram, system specifications	3/30/06
3. A working prototype	6/30/06
4. A final report with documentation	6/30/06
5. A workshop presentation	6/30/06

Note that the deliverables must be described in the proposal text in more depth than the single-line titles of the deliverables list. It is important to describe the contents of any deliverable reports or briefings and how these are expected to be used by the recipients of these deliverables.

E. Qualifications of Principal Investigator, Key Researchers and Collaborators

Describe previous experience and training in relevant areas of research (one-two paragraphs). When relevant, highlight the contribution of research collaborations (across disciplines and campuses or with private sector) to the project.

F. Vita

Curriculum vita or resume for the P.I. and each key researcher (2 pages maximum per individual).

G. Budget

Each proposal must include a project budget for each fiscal year and a total budget. Note that the state fiscal year ends June 30. Proposals covering **only the fiscal year 2005-2006** must include a budget for the period from project start date to June 30, 2005.

Multi-year proposals must include a **separate** budget for each fiscal year. Specifically, include budgets for the period from project start date to June 30, 2006, and for each subsequent fiscal year ending June 30. Also include a total budget for the project. Non-university respondents must provide an elemental cost breakdown on the form provided in the Appendix D. For each item, non-university respondents should specify cost-share as well as funds requested.

Proposers are encouraged to make use of the existing PATH experimental infrastructure for their projects. These include the UCI ATMS Testbed, the Berkeley Highway Laboratory, the PATH Experimental Vehicles, the PATH Intelligent Intersection and the PATH Instrumented Car, as described in Appendix B. The points of contact for these experimental laboratories are also included in Appendix B.

The costs attributable to experimental support using the UCI ATMS Testbed and the Berkeley Highway lab are not charged against the individual research project budgets. However, the providers of this support need to have a sufficiently clear description of each project's needs so that they can estimate their costs to support the project. Therefore, each proposal that expects to rely on these experimental facilities needs to define explicitly, by project fiscal year:

- any hardware additions or modifications needed
- any software additions or modifications needed
- test conditions planned, including number and duration of individual tests expected.

The costs associated with the use of the PATH Experimental Vehicles, Intelligent Intersection and Instrumented Car will be charged against the individual project budgets. In addition to the types of cost cited above, moving the vehicle to and from test sites, test site security, communications requirements, and travel costs to and from test sites should be taken into account when establishing a budget for the project.

H. Resources

Justify each major budget category relative to the research plan, project objectives and research contribution. Private sector respondents should highlight cost-sharing and clearly state how funds will be directed to the specific project.

I. Progress Reports

Current or former PATH P.I.s must submit a one-page statement of progress on **each** project funded under PATH, using the form provided at the end of this RFP.

J. Appendix

Cost Element Breakdown; PATH Progress Statement.

7. INNOVATIVE RESEARCH TOPICS (STEP TWO ONLY)

PATH is soliciting proposals on new and innovative ideas that were not identified in the RFP development process. The research topics that appear in the RFP reflect the judgments about importance of research problems made by Caltrans. However, there are likely to be other new and innovative ideas worth exploring that were not identified through the existing process. Therefore, we are requesting short proposals on the development of concepts that are not yet fully formulated, supporting exploratory research that could become the basis for a full-scale project in a future year. These proposals will not compete directly with the other proposals, but will be competing among themselves for a separate pool of funding. Any individual proposal budget must not exceed \$25,000.

Proposals for Innovative Research Topics will not proceed through the pre-proposal review process. Instead, they will be reviewed directly in Step Two of the process. They should be submitted electronically to PATH before the **deadline February 28, 2005**. These proposals will undergo review by academic researchers and Caltrans staff.

7.1 Proposal Instructions:

7.1.1 Proposals in response to this part of the RFP should be submitted through the RFP system using the link titled: "Upload Proposal - New and Innovative Topic".

7.1.2 The budget for any proposal submitted under this provision must not exceed \$25,000.

7.1.3 The page limit for a proposal submitted here is TEN pages, printed in 12-point font on 8.5 by 11 inch paper.

7.1.4 Each proposal should follow this outline:

- A. Abstract of up to 250 words, describing the proposed idea and its significance
- B. Clear definition of the idea being proposed for research.
- C. Explanation of why this idea is useful and needed, including:
 - Benefits to the transportation system
 - Contributions to knowledge
- D. Sketch out a general method of approach
- E. Provide background information, identifying the most relevant prior work in the subject area and how the proposed work would advance beyond that.
- F. Identify relevant experience and qualifications of the proposer(s)
- G. Identify resource needs, and include a detailed budget in support of that
- H. Identify project milestones and deliverables.

7.1.5 Proposals submitted here will be evaluated separately from proposals submitted in response to the main body of the RFP. The evaluation criteria for these proposals will be:

- Relevance of topic to PATH's goals
- Opportunity for this work to launch a significant, productive new research direction and/or to lead to a significant breakthrough discovery or development
- Creativity and originality of the idea
- Avoidance of duplication of other ongoing research
- Degree of understanding of the relevant issues shown in the proposal.

8. EVALUATION OF FULL PROPOSALS (STEP TWO)

PATH will screen full proposals (Step Two) to ensure that format requirements have been addressed. Proposers are encouraged to suggest the names and contact information of up to five out-of-state reviewers who are experts in the topic. Proposals will then be sent to academic and industry researchers for independent evaluation. PATH will provide to Caltrans the proposals, peer-reviews and recommendations for award. Caltrans will retain the final approval authority for award of contract. Proposals will be evaluated with respect to the following criteria:

- Utility of research outcome
- Feasibility of implementation of research outcome
- Research methodology
- Quality of research plan
- Qualifications of research team
- Budget

We strongly encourage collaborations with the private sector, between campuses, and across disciplines. We especially encourage collaborations that increase the value of the research to enable integrated solutions to major transportation challenges.

Proposals will compete both within and across research topics and there is no guarantee that a project will be awarded for every topic. In some cases, multiple projects may be awarded within the same topic.

9. FULL PROPOSAL SUBMITTAL (STEP TWO)

Each proposal, including the budget, must be made available in PDF format and submitted on-line at the PATH electronic **Proposal Submittal and Review website** at: <http://www.path.berkeley.edu/RFP>

For more information about how to submit proposals using this on-line Proposal Submittal and Review system, please visit the website listed above. **Proposals must be submitted within thirty days from date (TBD) of step two notification request by PATH** to receive consideration. The PATH Proposal Submittal and Review system will not accept any proposal that is submitted after 12 midnight PST on the specified date. We expect that proposers will be notified of funding decisions by the end of June 2005. PATH may ask the authors of successful proposals to modify their budgets as a condition for award. Contracts or Task Orders are expected to be processed by Fall 2005.

10. ADDENDA

No oral or written statements made by University personnel shall be considered addenda to this RFP unless that statement is contained in a written document identified as a written addendum to this RFP. Only the PATH Director issues official addenda or notices. PATH will not be responsible for any costs or expenses incurred by any proposer in connection with the preparation of its proposal.

11. TERMS AND CONDITIONS

11.1 Data Rights

Awardee agrees to maintain (in sufficient detail as will properly reflect research done and results achieved in the performance of this Agreement) books, records, reports, research notes, charts, graphs, comments, computations, analyses, recordings, photographs, computer programs, and documentation thereof, computer information storage means, samples of materials, and other written graphic or written data generated by the Awardee concerning the Work performed under this Agreement (hereinafter called "Data"). All Data and equipment produced or generated under this Agreement, including under any subcontracts or purchase orders for customized equipment or services, shall become the sole and separate property of University of California at Berkeley (hereinafter called "University"), and unpublished copies of such Data and the customized equipment shall be deliverable to University. University and Awardee shall have the rights in any resulting invention provided in 37 CFR part 401 "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," and any implementing regulations issued by the awarding agency. Awardee agrees that any work under this Agreement, but excluding preexisting work, constitutes a work(s) made for hire under the federal Copyright Act of 1976 ("the

Act"). To the extent said concept development does not constitute a work made for hire under the Act, Awardee will assign all right, title, and interest, including the copyright and all copyright rights, in the Work to University. Awardee hereby grants to University a royalty-free, non-exclusive irrevocable non-transferable license to reproduce, translate, publish, use and to authorize others to do so, all data collected. As used in this clause, data collected means the original records of scientific and technical data collected during the performance of the work by the Principal Investigator or the project personae. Data collected includes, but is not limited to notebooks, drawings, lists, specifications, and computations, in written, pictorial, graphic, or machine form.

11.2 Patent Rights

- A. When there is no Federal participation in the research project, the parties to this Agreement hereby mutually agree that, if patentable discoveries or inventions should result from work described herein, all rights accruing from such discoveries or inventions shall be the sole property of UC. However, UC agrees to and does hereby grant to Caltrans for state governmental purposes only, an irrevocable, non-exclusive, nontransferable and royalty-free license to practice each invention in the manufacture, use and disposition, according to law, of any article or material, and in the use of any method that may be developed as a part of the work under this Agreement. Such manufacture, use, and disposition, however, shall not be for commercial purposes or in competition with any commercial licensee(s) of the University.
- B. When Federal participation is provided through Caltrans for a research project, UC will provide the State of California and the Federal government with the same patent rights accorded the Federal government under Public Law 98-6520, "Patent Rights in Inventions Made with Federal Assistance."

11.3 Inspection of Work

The awardee shall permit PATH and Caltrans to review and inspect the research project activities at all reasonable times during the performance period of a contract or memorandum of understanding. When there is Federal participation in the research project, the awardee shall also permit the applicable Federal agency to review and inspect the research project activities at all reasonable times during the performance period. Any resulting award(s) will be subject to the examination and audit of the Auditor General of the State of California for a period of three (3) years after submission of the final invoice. The examination and audit will be confined to those matters connected with the performance of the contract including, but not limited to, the costs of administering the contract. With due respect for the reasonable convenience of awardee, PATH and Caltrans staff will be permitted to work side-by-side with the awardee to the extent and under conditions that may be requested by Caltrans or PATH. In this connection, Caltrans and PATH staff will be given access to all data, working papers, facilities, etc., which must be utilized in the performance of contracted services.

11.4 Publications

The awardee(s) will provide PATH and Caltrans the opportunity to review any proposed manuscripts describing results of work performed in whole or in part under any resulting contract. The reviews of draft reports will normally be completed within 45 days. In the event that PATH and/or Caltrans fails to provide the awardee with any comments on the draft report within 45 days of its submission, the awardee may proceed to the preparation of the final manuscript and its submission for formal acceptance in documentation of completion of contract objectives. Reference: *Publication Provisions Non-Federal Participating*, dated December 20, 1974, incorporated herein as "Section 10"; and *Publications Provisions Federal Participating*, dated December 13, 1974, incorporated herein as "Section 11."

11.5 Acknowledgment of Support and Disclaimer

Both an acknowledgment of support and disclaimer must appear in the publication of any material, including but not limited to copyrighted or other material developed under the award, in the following terms: "Prepared in cooperation with the State of California, Business, Transportation and Housing Agency, Department of Transportation, and Partners for Advanced Transit and Highways (PATH)." "The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California. This report does not constitute a standard, specification, or regulation."

11.6 Non-Discrimination

The awardee shall comply with regulations relative to Title VI (non-discrimination in federally-assisted programs of the Department of Transportation - Title 49 Code of Federal Regulations Part 21 - Effectuation of Title VI of the 1964 Civil Rights Act). Title VI provides that the recipients of federal assistance will implement and maintain a policy of non-discrimination in which no person in the state of California shall, on the basis of race, color, national origin, religion, sex, age, disability, be excluded from participation in, denied the benefits of or subjected to discrimination under any program or activity by the recipients of federal assistance or their assignees and successors in interest.

11.7 Publicity/Use of Name

The awardee will not use either the name of Caltrans or the University of California, either expressly or by implication, in any publicity or advertisement without the express written approval of the named party.

11.8 Major Personnel Changes

There shall be no change in the Principal Investigator or key researcher on a project without prior written approval by PATH and Caltrans.

11.9 Progress Reporting

As a condition of acceptance, all P.I.s will be required to submit quarterly progress reports and a final report. At the conclusion of the project, the P.I. will present his/her results in a workshop forum.

11.10 Adherence

All awards from University of California to private entities must adhere to the University's Terms and Conditions of Purchase and Service, as provided in Appendix A.

11.11 Inventory

11.11.1 UC and any subcontractor shall maintain an inventory record for each piece of nonexpendable equipment purchased or built with funds provided under terms of a Memorandum of Understanding. The inventory record for each piece of such equipment shall include its inventory control number, the date acquired, total cost, serial and model identification (on purchased equipment), and any other information or description necessary to identify the equipment. The inventory record shall include the location or section to which each piece of equipment is assigned, the number of the applicable research project's Memorandum of Understanding to which the special equipment is charged, and whether or not Federal money was involved in its purchase or construction.

11.11.2 Nonexpendable equipment to be so inventoried shall be those items of equipment which have a normal life expectancy of two years or more and an approximate unit price of less than five thousand dollars. In addition, other items of equipment costing less than five hundred dollars and being especially popular or attractive shall also be inventoried. Each item of nonexpendable equipment inventoried will have a tag affixed to it with its inventory control number shown thereon or with its inventory control number engraved directly on the item of nonexpendable equipment.

11.11.3 Periodically, but at least annually, UC shall provide Caltrans with a copy of UC's inventory record for nonexpendable equipment purchased with or built with funds provided under terms of the applicable Memorandum of Understanding. If no such nonexpendable equipment was purchased or constructed with said funds, formal notice to that effect shall be provided to Caltrans at least annually by UC.

11.12 Minority Business Enterprises

11.12.1 It is the policy of the State that disadvantaged business and women business enterprises as defined in 49 CFR Part 23 shall have the maximum opportunity to participate in the performance of contracts financed in whole or in part with Federal funds under this Interagency Agreement. Consequently, the disadvantaged business and women business enterprises requirements of 49 CFR Part 23 shall apply to this Interagency Agreement..

11.12.2 UC agrees to ensure that disadvantaged business and women business enterprises as defined in 49 CFR Part 23 have the maximum opportunity to participate in the

performance of any subcontracts financed in whole or in part with Federal funds provided by Memorandum of Understandings under this Interagency Agreement. In this regard, UC shall take all necessary and reasonable steps in accordance with 49 CFR Part 23 to ensure that disadvantaged business and women business enterprises have the maximum opportunity to compete for and perform any subcontracts. UC and any subcontractors shall not discriminate on the basis of race, color, national origin, or sex in the award and performance of any work done under the provisions of this Interagency Agreement.

12. PUBLICATIONS PROVISIONS – NON-FEDERAL PARTICIPATING

12.1 General

The word, “State,” as used herein refers to the California Department of Transportation. These Publication Provisions are to provide for adequate documentation of the completed contract obligations, to encourage publication and distribution of research information, and to protect the State from unwarranted implications of policy or concurrence with the conclusions of the contractor.

12.2 Review of Reports

The process of the State’s review of the drafts of interim and final research reports to ensure adequate compliance with provisions of this agreement will include:

12.2.1 A general technical review to ensure that all aspects of the study provided for by this agreement have been adequately carried out and documented. Correction of deficiencies found in this review is a requirement for the State’s acceptance of a report as evidence of partial or final fulfillment of the agreement objectives.

12.2.2 Consideration as to whether or not the organization, language and content of the report are presented in a manner that will be intelligible to its intended audience. Reports on studies that produce an implementable product in the form of a device, procedure or the like must be written in a manner understandable to the user. Where studies conclude with intermediate research results, they may be written in the language of that research field but must contain a technical summary in terms intelligible to the user of the ultimate system to which the research is expected to contribute and in sufficient detail to permit the practicing engineer to implement the items. Correction of deficiencies found in this review is also a requirement for the State’s acceptance of a report as satisfactory documentation of the agreement requirements.

12.2.3 An analysis of the recommendations and conclusions of the report in relationship to the data and theories developed therein to determine whether or not the State concurs that the contractor’s recommendations and conclusions are supported by the data. Recognizing that professional differences of opinion do arise, the concurrence of the contractor with review comments of this type is not a requirement for acceptance, but may affect decisions regarding State distribution of the report and use of the research results.

12.2.4 General comments on the technical content and presentation may be furnished for the optional use of the author in preparing the manuscript for publication.

12.3 Acknowledgment and Disclaimer Statements

All reports published by the Contractor under provisions of this agreement shall contain the following:

12.3.1 A credit reference: “Prepared in cooperation with the State of California, Business Transportation and Housing Agency, Department of Transportation.”

12.3.2 A disclaimer statement: “The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California. This report does not constitute a standard, specification, or regulation.”

12.4 Publication Rights

Reports prepared by the contractor under provisions of this agreement may be published under the following conditions:

12.4.1 Any material contained in interim or final reports which have received final acceptance by the State may be published in any form and through any media the contractor may desire without further written permission by the State, subject only to the inclusion of credit and disclaimer statements of Sections C-1 and C-2 of these Publication Provisions.

12.4.2 In the event that the contractor cannot agree with the comments of the State, the contractor may publish the material contained in the report 70 days after it has been resubmitted in final form to the State subject to the inclusion of (1) a statement that the State does not concur with the findings and conclusions of the research, and (2) the credit and disclaimer statements of Sections C-1 and C-2 of these Publication Provisions. In the event of said lack of agreement, the contractor may include the State’s technical comments in the report in a clearly identified section such as “Sponsor’s comments.”

12.4.3 The State reviews of draft reports will normally be completed within 90 days. In the event that the State fails to provide the contractor with any comments on the draft reports within 130 days of its submission by the contractor, the contractor may proceed to the preparation of the final manuscript and its submission for formal acceptance in documentation of completion of contract objectives. The State will authorize the contractor to publish the material contained in the report 40 days after it has been resubmitted in final form to the State, subject to the inclusion of (1) a statement that the State has not completed its review of the report, and (2) the credit and disclaimer statements of Sections C-1 and C-2 of these Publication Provisions.

12.5 Dissemination of Results

The contractor may publish the results of the study or any of its particulars in separate reports or by submission of technical papers to professional organizations subject to these Publication Provisions. Both written and oral releases are considered to be within the context of publication. However, there is no intention to limit discussions of the study with small technical groups or lectures to employees or students. Lectures to other groups which describe the plans but disclose neither data nor results are permissible without advance review by the State.

12.6 Presentation of Papers and Articles

In unusual cases when the scheduled time for the preparation of a technical paper, containing previously undisclosed findings, for presentation at professional meetings or submission to professional organizations does not permit time for formal review and acceptance, an abstract and notification of intent to present the paper should be submitted for State concurrence. Such concurrence will normally be given unless there is indication of new and controversial findings and conclusions based on data that the State has not been given adequate opportunity to review. To protect the interest of the State such presentation should contain (1) a statement that the State has not reviewed the paper, and (2) the credit and disclaimer statements of Sections C-1 and C-2 of these Publications Provisions. Draft copies of these papers should be submitted for State review as soon as completed.

12.7 Copyright

The contractor shall be free to copyright material developed under the agreement with the provision that the State reserve a royalty-free, nonexclusive, and irrevocable license to reproduce, publish or otherwise use, and to authorize others to use, the work for Government purposes.

13. PUBLICATIONS PROVISIONS – FEDERAL PARTICIPATING

13.1 General

The word “State,” as used herein refers to the California Department of Transportation. These Publications Provisions are to provide for adequate documentation of the completed contract obligations, to encourage publication and distribution of research information, and to protect the State and the Federal Highway Administration from unwarranted implications of policy or concurrence with the conclusions of the contractor.

13.2 Review of Reports

The process of the State’s and the Federal Highway Administration’s review of the drafts of interim and final research reports to ensure adequate compliance with provisions of this agreement will include:

13.2.1 A general technical review to ensure that all aspects of the study provided for by this agreement have been adequately carried out and documented. Correction of

deficiencies found in this review is a requirement for the State's and the Federal Highway Administration's acceptance of a report as evidence of partial or final fulfillment of the agreement objectives.

13.2.2 Consideration as to whether or not the organization, language and content of the report are presented in a manner which will be intelligible to its intended audience. Reports on studies which produce an implementable product in the form of a device, procedure or the like must be written in a manner understandable to the user. Where studies conclude with intermediate research results, they may be written in the language of that research field but must contain a technical summary in terms intelligible to the user of the ultimate system to which the research is expected to contribute and in sufficient detail to permit the practicing engineer to implement the items. Correction of deficiencies found in this review is also a requirement for the State's and the Federal Highway Administration's acceptance of a report as satisfactory documentation of the agreement requirements.

13.2.3 An analysis of the recommendations and conclusions of the report in relationship to the data and theories developed therein to determine whether or not the State and the Federal Highway Administration concur that the contractor's recommendations and conclusions are supported by the data. Recognizing that professional differences of opinion do arise, the concurrence of the contractor with review comments of this type is not a requirement for acceptance, but may affect decisions regarding State and Federal Highway Administration distribution of the report and use of the research results.

13.2.4 General comments on the technical comment and presentation may be furnished for the optional use of the author in preparing the manuscript for publication.

13.3 Acknowledgment and Disclaimer Statements

All reports published by the State and/or the contractor under provisions of this agreement shall contain the following:

13.3.1 Credit reference: "Prepared in cooperation with the State of California, Business Transportation and Housing Agency, Department of Transportation and the U.S. Department of Transportation Federal Highway Administration".

13.3.2 Disclaimer statement: "The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation."

13.4 Publication Rights

Reports prepared by the contractor under provisions of this agreement may be published under the following conditions:

13.4.1 Any material contained in interim or final reports which have received final acceptance by the State and the Federal Highway Administration may be published in any form and through any media the contractor may desire without further written permission by the State or the Federal Highway Administration, subject only to the inclusion of credit and disclaimer statements of Sections C-1 and C-2 of these Publication Provisions.

13.4.2 In the event that the contractor cannot agree with the comments of the State or the Federal Highway Administration, the contractor may publish the material contained in the report 70 days after it has been resubmitted in final form to the State subject to the inclusion of (1) a statement that the Federal Highway Administration does not concur with the findings and conclusions of the research, and (2) the credit and disclaimer statements of Sections C-1 and C-2 of these Publication Provisions. In the event of said lack of agreement, the contractor may include the State's and the Federal Highway Administration's technical comments in the report in a clearly identified section such as "Sponsor's comments."

13.4.3 Federal Highway Administration reviews of draft reports will normally be completed within 90 days of submission by the State. In the event that the State fails to provide the contractor with any comments on the draft report within 130 days of its submission by the contractor, the contractor may proceed to the preparation of the final manuscript and its submission for formal acceptance in documentation of completion of contract objectives. The State will authorize the contractor to publish the material contained in the report 40 days after it has been resubmitted in final form to the State, subject to the inclusion of (1) a statement that the Federal Highway Administration has not completed its review of the report, and (2) the credit and disclaimer statements of Sections C-1 and C-2 of these Publication Provisions.

13.5 Dissemination of Results

The contractor may publish the results of the study or any of its particulars in separate reports or by submission of technical papers to professional organizations subject to these Publication Provisions. Both written and oral releases are considered to be within the context of publication. However, there is no intention to limit discussions of the study with small technical groups or lectures to employees or students. Lectures to other groups that describe the plans but disclose neither data nor results are permissible without advance review by the State and the Federal Highway Administration.

13.6 Presentation of Papers and Articles

In unusual cases when the scheduled time for the preparation of a technical paper, containing previously undisclosed findings, for presentation at professional meetings or submission to professional organizations does not permit time for formal review and acceptance, an abstract and notification of intent to present the paper should be submitted through the normal channels for State and Federal Highway Administration concurrence. Such concurrence will normally be given unless there is indication of new and controversial findings and conclusions based on data that the State and the Federal

Highway Administration have not been given adequate opportunity to review. To protect the interest of the sponsoring agencies, such presentation should contain (1) a statement that the sponsoring agencies have not reviewed the paper, and (2) the credit and disclaimer statements of Sections C-1 and C-2 of these Publication Provisions. Draft copies of these papers should be submitted through normal channels for State and Federal Highway Administration review as soon as completed.

13.7 Copyright

The contractor shall be free to copyright material developed under the agreement with the provision that the State and the Federal Highway Administration reserve a royalty-free, nonexclusive, and irrevocable license to reproduce, publish or otherwise use, and to authorize others to use, the work for Government purposes.

14. APPENDICES

- A. University of California Terms and Conditions of Purchase.
- B. Experimental Support Facilities
- C. University of California Business Information Form.
- D. Cost-Element Breakdown.
- E. Non-Discrimination Statement and Non-Segregation Statement.
- F. PATH Progress Statement.

**A. UNIVERSITY OF CALIFORNIA
TERMS AND CONDITIONS OF PURCHASE**

University of California

Terms and Conditions of Purchase

ARTICLE 1 - The materials, supplies or services covered by this order shall be furnished by Seller subject to all the terms and conditions set forth in this order including the following, which Seller, in accepting this order, agrees to be bound by and to comply with in all particulars and no other terms or conditions shall be binding upon the parties unless hereafter accepted by them in writing. Written acceptance or shipment of all or any portion of the materials or supplies, or the performance of all or any portion of the services, covered by this order shall constitute unqualified acceptance of all its terms and conditions. The terms of any proposal referred to in this order are included and made a part of the order only to the extent it specifies the materials, supplies, or services ordered, the price therefor, and the delivery thereof, and then only to the extent that such terms are consistent with the terms and conditions of this order.

ARTICLE 2 - INSPECTION. The services, materials and supplies furnished shall be exactly as specified in this order free from all defects in Seller's performance, design, workmanship and materials, and, except as otherwise provided in this order, shall be subject to inspection and test by University at all times and places. If, prior to final acceptance, any services and any materials and supplies furnished therewith are found to be incomplete, or not as specified, University may reject them, require Seller to correct them without charge, or require delivery of such materials, supplies, or services at a reduction in price which is equitable under the circumstances. If Seller is unable or refuses to correct such items within a time deemed reasonable by University, University may terminate the order in whole or in part. Seller shall bear all risks as to rejected services and, in addition to any costs for which Seller may become liable to University under other provisions of this order, shall reimburse University for all transportation costs, other related costs incurred, or payments to Seller in accordance with the terms of this order for unaccepted services and materials and supplies incidental thereto. Notwithstanding final acceptance and payment, Seller shall be liable for latent defects, fraud or such gross mistakes as amount to fraud.

ARTICLE 3 CHANGES. University may make changes within the general scope of this order in drawings and specifications for specially manufactured supplies, place of delivery, method of shipment or packing of the order by giving notice to Seller and subsequently confirming such changes in writing. If such changes affect the cost of or the time required for performance of this order, an equitable adjustment in the price or delivery or both shall be made. No change by Seller shall be allowed without written approval of University. Any claim of Seller for an adjustment under this Article must be made in writing within thirty (30) days from the date of receipt by Seller of notification of such change unless University waives this condition in writing. Nothing in this Article shall excuse Seller from proceeding with performance of the order as changed hereunder.

ARTICLE 4 TERMINATION

A. University may, by written notice stating the extent and effective date, cancel and/or terminate this order for convenience in whole or in part, at any time. University shall pay Seller as full compensation for performance until such termination:

(1) the unit or pro rata order price for the performed and accepted portion; and

(2) a reasonable amount, not otherwise recoverable from other sources by Seller as approved by University, with respect to the unperformed or unaccepted portion of this order, provided compensation hereunder shall in no event exceed the total order price.

B. University may by written notice terminate this order for Seller's default, in whole or in part, at any time, if Seller refuses or fails to comply with the provisions of this order, or so fails to make progress as to endanger performance and does not cure such failure within a reasonable period of time, or fails to perform the services within the time specified or any written extension thereof. In such event, University may purchase or otherwise secure services and, except as otherwise provided herein, Seller shall be liable to University for any excess costs occasioned University thereby. If, after notice of termination for default, University determines that the Seller was not in default or that the failure to perform this order was due to causes beyond the control and without the fault or negligence of Seller (including, but not restricted to, acts of God or of the public enemy, acts of University, acts of Government, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather, and delays of a subcontractor or supplier

due to such causes and without the fault or negligence of the subcontractor or supplier), termination shall be deemed for the convenience of University, unless University shall determine that the services covered by this order were obtainable by Seller from other sources in sufficient time to meet the required performance schedule.

C. If University determines that Seller has been delayed in the work due to causes beyond the control and without the fault or negligence of Seller, University may extend the time for completion of the work called for by this order, when promptly applied for in writing by Seller; any extension granted shall be effective only if given in writing. If such delay is due to failure of University, not caused or contributed to by Seller, to perform services or deliver property in accordance with the terms of the order, the time and price of the order shall be subject to change under the Changes Article. Sole remedy of Seller in event of delay by failure of University to perform shall, however, be limited to any money actually and necessarily expended in the work during the period of delay, solely by reason of the delay. No allowance will be made for anticipated profits.

D. The rights and remedies of University provided in this Article shall not be exclusive and are in addition to any other rights and remedies provided by law or under this order.

E. As used in this Article, the word "Seller" includes Seller and its subsuppliers at any tier.

ARTICLE 5 LIABILITY FOR UNIVERSITY FURNISHED PROPERTY.

Seller assumes complete liability for any tooling, articles or material furnished by University to Seller in connection with this order and Seller agrees to pay for all such tooling, articles or material damaged or spoiled by it or not otherwise accounted for to University's satisfaction. The furnishing to Seller of any tooling, articles, or material in connection with this order shall not, unless otherwise expressly provided, be construed to vest title thereto in Seller.

ARTICLE 6 TITLE. Title to the material and supplies purchased hereunder shall pass directly from Seller to University at the f.o.b. point shown, or as otherwise specified in this order, subject to the right of University to reject upon inspection.

ARTICLE 7 - PAYMENT, EXTRA CHARGES, DRAFTS. Seller shall be paid, upon submission of acceptable invoices, for materials and supplies delivered and accepted or services rendered and accepted. University will not pay cartage, shipping, packaging or boxing expenses, unless specified in this order. Drafts will not be honored. Invoices must be accompanied by shipping documents or photocopies of such, if transportation is payable and charged as a separate item.

ARTICLE 8 CHARACTER OF SERVICES. Seller, as an independent contractor, shall furnish all equipment, personnel and material sufficient to provide the services expeditiously and efficiently during as many hours per shift and shifts per week and at such locations as the University may so require and designate.

ARTICLE 9 - FORCED, CONVICT, AND INDENTURED LABOR

A. By accepting this order, Seller hereby certifies that no foreign-made equipment, materials, or supplies furnished to the University pursuant to this order will be produced in whole or in part by forced labor, convict labor, or indentured labor under penal sanction.

B. Any Seller contracting with the University who knew or should have known that the foreign-made equipment, materials, or supplies furnished to the University were produced in whole or in part by forced labor, convict labor, or indentured labor under penal sanction, when entering into a contract pursuant to the above, may have any or all of the following sanctions imposed:

(1.) The contract under which the prohibited equipment, materials, or supplies were provided may be voided at the option of the University.

(2.) Seller may be removed from consideration for University contracts for a period not to exceed 360 days.

ARTICLE 10 INDEMNITY.

A. General. Seller shall defend, indemnify, and hold harmless University, its officers, employees, and agents, from and against all losses, expenses (including attorneys' fees), damages, and liabilities of any kind resulting from or arising out of this agreement and/or Seller's performance hereunder, provided such losses, expenses, damages and liabilities are due or claimed to

be due to the negligent or willful acts or omissions of Seller, its officers, employees, agents, subcontractors, or anyone directly or indirectly employed by them, or any person or persons under Seller's direction and control.

B. Proprietary Rights. Seller shall indemnify, defend, and hold harmless University, its officers, agents, and employees against all losses, damages, liabilities, costs, and expenses (including but not limited to attorneys' fees) resulting from any judgment or proceeding in which it is determined, or any settlement agreement arising out of the allegation, that Seller's furnishing or supplying University with parts, goods, components, programs, practices, or methods under this order or University's use of such parts, goods, components, programs, practices, or methods supplied by Seller under this order constitutes an infringement of any patent, copyright, trademark, trade name, trade secret, or other proprietary or contractual right of any third party. The foregoing shall not apply unless University has informed Seller as soon as practicable of the suit or action alleging such infringement. Seller shall not settle such suit or action without the consent of University. University retains the right to participate in the defense against any such suit or action.

C. Products. Seller shall fully indemnify, defend, and hold harmless University from and against any and all claim, action, and liability, for injury, death, and property damage, arising out of the dispensing or use of any of Seller's product provided under authorized University orders. In addition to the liability imposed by law on the Seller for damage or injury (including death) to persons or property by reason of the negligence, willful acts or omissions, or strict liability of the Seller or his agents, which liability is not impaired or otherwise affected hereby, the Seller hereby assumes liability for and agrees to save University harmless and indemnify it from every expense, liability or payment by reason of any damage or injury (including death) to persons or property suffered or claimed to have been suffered through any act or omission of the Seller.

The University agrees to provide Seller with prompt notice of any such claims and to permit Seller to defend any claim or suit, and that it will cooperate fully in such defense.

ARTICLE 11 DECLARED VALUATION OF SHIPMENTS. Except as otherwise provided on the face of this order, all shipments by Seller under this order for University's account shall be made at the maximum declared value applicable to the lowest transportation rate or classification and the bill of lading shall so note

ARTICLE 12- WARRANTY. Seller agrees that the supplies or services furnished under this order shall be covered by the most favorable commercial warranties the Seller gives to any customer for the same or substantially similar supplies or services, or such other more favorable warranties as specified in this order. The rights and remedies so provided are in addition to and do not limit any rights afforded to University by any other article of this order. Such warranties will be effective notwithstanding prior inspection and/or acceptance of the services or supplies by the University.

ARTICLE 13- ASSIGNMENT AND SUBCONTRACTING. This order is assignable by University. Except as to any payment due hereunder, this order may not be assigned or subcontracted by Seller without written approval of University. In case such consent is given, it shall not relieve Seller from any of the obligations of this Agreement and any transferee or subcontractor shall be considered the agent of Seller and, as between the parties hereto, Seller shall be and remain liable as if no such transfer or subcontracting had been made.

ARTICLE 14- EQUAL OPPORTUNITY AFFIRMATIVE ACTION. Seller shall not maintain or provide racially segregated facilities for employees at any establishment under its control. Seller agrees to adhere to the requirements set forth in Executive Orders 11246 and 11375, and with respect to activities occurring in the State of California, to the California Fair Employment and Housing Act (Government Code section 12900 et seq.). Expressly, Seller shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, ancestry, medical condition (as defined by California Code section 12925f), marital status, age, physical and mental handicap in regard to any position for which the employee or applicant for employment is qualified, or because he or she is a disabled veteran or veteran of the Vietnam era. Seller shall further specifically undertake affirmative action regarding the hiring, promotion and treatment of minority group persons, women, the handicapped, and disabled veterans and veterans of the Vietnam era. Seller shall communicate this policy in both English and Spanish to all persons concerned within its company, with outside recruiting services, and the minority community at large. Seller shall provide the University on request a breakdown of its labor force by groups, specifying the above characteristics within job categories, and

shall discuss with the University its policies and practices relating to its affirmative action programs.

ARTICLE 15 The clauses contained in the following paragraphs of the Federal Acquisition Regulations are incorporated by reference. The full text is available upon request:

FAR 52.222-04 Contract Work Hours and Safety Standards Act

FAR 52.222-26 Equal Opportunity

FAR 52.223-02 Clean Air and Water (If order exceeds \$100,000)

ARTICLE 16- WORK ON UNIVERSITY OR GOVERNMENT PREMISES. If Seller's work under this order involves performance by Seller at University or United States Government owned sites or facilities, the following provisions shall apply:

A. Liens. Seller agrees that at any time upon request of University he will submit a sworn statement setting forth the work performed or material furnished by subcontractors, suppliers and materialmen, and the amount due and to become due to each, and that before the final payment called for hereunder, will if requested, submit to University a complete set of vouchers showing what payments have been made for materials and labor used in connection with the work called for hereunder.

Seller shall:

(1) Indemnify and hold harmless University from all claims, demands, causes of action or suits, of whatever nature, arising out of the services, labor and materials furnished by Seller or its subcontractors under this order, and from all laborers', materialmen's and mechanics' liens upon the real property upon which the work is located or any other property of University;

(2) Promptly notify University in writing, of any such claims, demands, causes of action, or suits brought to its attention. Seller shall forward with such notification copies of all pertinent papers received by Seller with respect to any such claims, demands, causes of action or suits and, at the request of University shall do all things and execute and deliver all appropriate documents and assignments in favor of University of all Seller's rights and claims growing out of such asserted claims as will enable University to protect its interest by litigation or otherwise. The final payment shall not be made until Seller, if required, shall deliver to University a complete release of all liens arising out of this order, or receipts in full in lieu thereof, as University may require, and if required in either case, an affidavit that as far as it has knowledge or information, the receipts include all the labor and materials for which a lien could be filed; but Seller may, if any subcontractor refuses to furnish a release or receipt in full, furnish a bond satisfactory to University to indemnify it against any claim by lien or otherwise. If any lien or claim remains unsatisfied after all payments are made, Seller shall refund to University all monies that the latter may be compelled to pay in discharging such lien or claim, including all costs and reasonable attorneys' fees.

B. Cleaning Up. Seller shall at all times keep University premises where the work is performed and adjoining premises free from accumulations of waste material or rubbish caused by its employees or work of any of its subcontractors, and, at the completion of the work; shall remove all rubbish from and about the building and all its and its subcontractors' tools, scaffolding, and surplus materials, and shall leave the work "broom clean" or its equivalent, unless more exactly specified. In case of dispute between Seller and the subcontractors employed on or about the structure or structures upon which the work is to be done, as herein provided, as to responsibility for the removal of the rubbish, or in case the same be not promptly removed as herein required, University may remove the rubbish and charge the cost to Seller.

C. Employees. Seller shall not employ on the work any unfit person or anyone not skilled in the work assigned to him or her, and shall devote only its best-qualified personnel to work under this order. Should University deem anyone employed on the work incompetent or unfit for his or her duties and so inform Seller, Seller shall immediately remove such person from work under this order and he or she shall not again, without written permission of University, be assigned to work under this order.

It is understood that if employees of University shall perform any acts for the purpose of discharging the responsibility undertaken by the Seller in this Article 15, whether requested to perform such acts by the Seller or not, such employees of the University while performing such acts shall be considered the agents and servants of the Seller subject to the exclusive control of the Seller.

D. Safety, Health and Fire Protection. Seller shall take all reasonable precautions in the performance of the work under this order to protect the health and safety of employees and members of the public and to minimize danger from all hazards to life and property, and shall comply with all health, safety, and fire protection regulations and requirements (including reporting requirements) of University. In the event that Seller fails to comply with said regulations or requirements of University, University may, without prejudice to any other legal or contractual rights of University, issue an order stopping

Appendix A

all or any part of the work; thereafter a start order for resumption of work may be issued at the discretion of the University. Seller shall make no claim for extension of time or for compensation or damages by reason of or in connection with such work stoppage.

The safety of all persons employed by Seller and its subcontractors on University premises, or any other person who enters upon University premises for reasons relating to this order, shall be the sole responsibility of Seller. Seller shall at all times maintain good order among its employees and shall not employ on the work any unfit person or anyone not skilled in the work assigned to him or her. Seller shall confine its employees and all other persons who come onto University's premises at Seller's request or for reasons relating to this order and its equipment to that portion of University's premises where the work under this order is to be performed or to roads leading to and from such work sites, and to any other area which University may permit Seller to use. Seller shall take all reasonable measures and precautions at all times to prevent injuries to or the death of any of its employees or any other person who enters upon University premises. Such measures and precautions shall include, but shall not be limited to, all safeguards and warnings necessary to protect workers and others against any conditions on Owner's premises which could be dangerous and to prevent accidents of any kind whenever work is being performed in proximity to any moving or operating machinery, equipment or facilities, whether such machinery, equipment or facilities are the property of or me being operated by, the Seller, its subcontractors, the University or other persons.

To the extent compliance is required, Seller shall comply with all University safety rules and regulations when on University premises.

ARTICLE 17 - INSURANCE

Seller shall defend, indemnify, and hold the University, its officers, employees, and agents harmless from and against any and all liability, loss, expense (including reasonable attorneys' fees), or claims for injury or damages that are caused by or result from the negligent or intentional acts or omissions of Seller, its officers, agents, or employees.

Seller, at its sole cost and expense, shall insure its activities in connection with the work under this order and obtain, keep in force, and maintain insurance as follows:

A. Comprehensive or Commercial Form General Liability Insurance (contractual liability included) with limits as follows:

Each Occurrence	\$ _____
Products/Completed Operations Aggregate	\$ _____
Personal and Advertising Injury	\$ _____
General Aggregate (Not applicable to the Comprehensive Form)	\$ _____

If the above insurance is written on a claims-made form, it shall continue for three years following termination of this Agreement. The insurance shall have a retroactive date of placement prior to or coinciding with the effective date of this Agreement.

B. Business Automobile Liability Insurance for owned, scheduled, non-owned, or hired automobiles with a combined single limit not less than _____ dollars (\$ _____) per occurrence.

(REQUIRED ONLY IF SELLER DRIVES ON UNIVERSITY PREMISES IN THE COURSE OF PERFORMING WORK FOR UNIVERSITY.)

C. Professional Liability Insurance with a limit of _____ dollars (\$ _____) per occurrence with an aggregate of not less than _____ dollars (\$ _____).

If this insurance is written on a claims-made form, it shall continue for three years following termination of this Agreement. The insurance shall have a retroactive date of placement prior to or coinciding with the effective date of this Agreement.

D. Workers' Compensation as required by California State law.

It is understood that the coverage and limits referred to under a., b., and c. above shall not in any way limit the liability of Seller. Seller shall furnish the University with certificates of insurance evidencing compliance with all requirements prior to commencing work under this Agreement. Such certificates shall:

(1) Provide for thirty (30)-days advance written notice to the University of any modification, change, or cancellation of any of the above insurance coverage.

(2) Indicate that The Regents of the University of California has been endorsed as an additional insured for the coverage referred to under a. and b.

This provision shall only apply in proportion to and to the extent of the negligent acts or omissions of Seller, its officers, agents, or employees.

(3) Include a provision that the coverage will be primary and will not participate with nor be excess over any valid and collectible insurance or program of self-insurance carried or maintained by the University.

ARTICLE 18 - PERMITS. Seller agrees to procure all necessary permits or licenses and abide by all applicable laws, regulations and ordinances of the United States and of the state, territory and political subdivision in which the work under this order is performed. Seller shall be liable for all damages and shall indemnify and save University harmless from and against all damages and liability which may arise out of failure of Seller to secure and pay for any such licenses or permits or to comply fully with any and all applicable laws, ordinances and regulations.

ARTICLE 19 COOPERATION. Seller and its subcontractors, if any, shall cooperate with University and other vendors and contractors on the premises and shall so carry on their work that other cooperating vendors and contractors shall not be hindered, delayed or interfered with in the progress of their work, and so that all of such work shall be a finished and complete job of its kind.

ARTICLE 20 - WAIVER OF DEFAULT. Any failure of University at any time, or from time to time, to enforce or require the strict keeping and performance by Seller of any of the terms or conditions of this order shall not constitute a waiver by University of a breach of any such terms or conditions and shall not affect or impair such terms or conditions in any way, or the right of University at any time to avail itself of such remedies as it may have for any such breach or breaches of such terms or conditions.

ARTICLE 21 TAXES. Seller shall pay all contributions, taxes and premiums payable under federal, state and local laws measured upon the payroll of employees engaged in the performance of work under this order, and all applicable sales, use, excise, transportation, privilege, occupational and other taxes applicable to materials and supplies furnished or work performed hereunder and shall save University harmless from liability for any such contributions, premiums, and taxes.

ARTICLE 22 - OTHER APPLICABLE LAWS. Any provision required to be included in a contract of this type by any applicable and valid federal, state or local law, ordinance, rule or regulations shall be deemed to be incorporated herein.

ARTICLE 23 GOVERNING LAW. The law of the State of California shall control this Appendix and any document to which it is appended.

B. EXPERIMENTAL SUPPORT FACILITIES (Modified)

California ATMS Testbed at UC Irvine

The ATMS Testbed Program was initiated in early 1991 to provide an instrumented, multi-jurisdictional, multi-agency transportation operations environment linked to university laboratories for real-world development, testing and evaluation of near-term technologies and applications, and to serve as an ongoing testing ground for California and national ITS efforts. Located in Orange County, California, and under the direction of the UCI Institute of Transportation Studies, the Testbed is intended to:

- accelerate deployment through advanced technology research;
- demonstrate the readiness of advanced systems;
- implement and evaluate operations of an integrated multi-jurisdictional, multi-agency transportation operations system.

The Testbed is based on real-time, computer-assisted traffic management and communication. The transportation operations system that forms the backbone of the Testbed is structured to provide intelligent computer-assisted decision support to traffic management personnel by integrating network-wide traffic information (both surface street and freeway) in a real-time environment. The Testbed currently either has, or is developing, direct links to three traffic operations centers (Caltrans District 12 TMC, City of Anaheim TMC, and City of Irvine Transportation Research and Analysis Center) that provide real-time data links from area freeways and major arterials directly to dedicated Testbed research laboratories located at UCI.

The broad mission of the Testbed Program is to work toward overcoming institutional, technical and philosophical barriers to introducing innovative technologies into the management of complex transportation systems. Working together with California PATH and the Testbed Partners, the Testbed Research Implementation and Prototype Development Program is designed to establish an intermediary link between basic research in ATMS/ATIS technologies (supported both by PATH and USDOT) and their full deployment.

Testbed Facility and Supporting Infrastructure

The Testbed covers the entire freeway system in Orange County and two contiguous sub-areas comprising an arterial system that includes most of the major decision points for freeway travelers in the region. The City of Anaheim sub-area encompasses the City's major special event traffic generators and is centered about two of its designated "smart streets," Harbor Boulevard and Katella Avenue. This sub-area is ideal for network-wide applications of advanced technologies in traffic management. The City of Irvine sub-area provides freeway access to many business and office complexes on both sides of the 1-5 freeway and is ideal for corridor-level integration of real-time communication and control in traffic management.

A comprehensive testing and evaluation system has been established to support activities in the Testbed. The system has been developed to interface with existing traffic surveillance and control components and provide a common integrated real-time traffic database for ATMS research conducted within the Testbed. The system design is built upon a wide-area communications network backbone linking the Cities of Anaheim and

Irvine Transportation Management Centers (TMCs) to the California Department of Transportation's District 12 TMC and with the ATMS Research Laboratories at the UCI Institute of Transportation Studies. The communications network is configured to permit easy future expansion to accommodate appropriate private/public sector research implementation projects that may be conducted within the Testbed.

- Testbed Labs
- Data Streams
 - Historical
 - Real-time
- Surveillance
 - Freeway
 - Arterial
- Real-time Vehicle Tracking
- Travel Behavior Monitoring
- Microscopic Simulation
- Mobile Surveillance & Transportation Management Capability

Testbed Laboratories

The Testbed laboratories form a computerized research environment connected to the real world transportation system. The laboratories are a testing ground for the development of particular ATMS *modules* and of integrated ATMS *applications*. The goal is for the Testbed laboratories to have a complete simulation of the transportation systems that are part of the Testbed. The Paramics (parallel microsimulation) traffic model is the core simulation for the Testbed laboratories. It can simulate all of the existing and currently envisioned traffic measurement and control devices associated with ATMS.

Data Streams

Currently, historical freeway data (all CT D12 systems) is available. These data are accessed via command line executables. Users request data with the following information:

- freeway id (405, 55, 133, etc)
- direction (N,S,W,E)
- start and end postmiles
- start and end times

Data is available in the following format:

- vds id & timestamp
- lane & loop count
- volume, occupancy, status,

and can be placed on an ftp site for download.

Real-time freeway data are available currently only on the Testbed lab PTL network via a CORBA interface. Users wishing to access these data must do so on-site; IDL's will be supplied to the researcher so they can build client applications with stubs for the CORBA functions.

Real-time arterial data from the City of Irvine are currently available only at the following intersections:

- Alton@Technology Way
- Alton@Irvine Center Drive
- Alton@Gateway

These traffic data from the City of Irvine are transmitted over an IP network between UCI/ITS and the City of Irvine and stored on a dedicated machine at UCI/ITS via serial interface collection unit in a Windows NT environment on field processors (servers). The count data are collected from Sarasota detector devices across the serial interface between the PC and the detector.

Surveillance

A detector test site has been constructed comprising: in-pavement, overhead- and side-mount detection capability at two locations on I-405: Sand Canyon Avenue and Laguna Canyon Road. The overhead mounts include “ground truth” video cameras over each lane, connected to a bank of VCRs and to an automated video image capture and re-identification system. Side mounts include:

- OMRON Vision Sensor detector
- Remote Traffic Microwave Sensor (RTMS) radar sensor detector
- Pan-Tilt-Zoom (PTZ) Webcam
- Spread spectrum Radios (SSR)

There are double loops in all traffic lanes, and ISI (Blade) loops will be installed early 2002. For ease of access, the Sand Canyon and Laguna Canyon loop and video data are transferred to a nearby local City street intersection via SSR; the data can also be retrieved at Sand Canyon off ramp controller cabinet. In addition, all loop data are available at the UCI-ITS lab, or via DSL connection through a local webserver.

Real-time Vehicle Tracking

The Testbed has the capability of real-time vehicle tracking using a series of Extensible Data Collection Units (Tracer EDCU), employing 12-channel Garmin GPS 35 TracPak, with communications providing web-based CDPD 2-way wireless data transfer. These units are portable, self-actuating, and powered from a standard DC outlet (e.g., cigar lighter) in the vehicle. The units are coupled to OpenMap GIS for analysis and display, and can be integrated with the REACT! CASI survey instrument. These units have applications to:

- Traffic Monitoring / Vehicle Probes
- Route Choice Studies
- Travel Behavior Surveys with REACT!
- Extensions to Route Guidance

Travel Behavior Monitoring

A comprehensive activity/travel survey instrument, REACT!, is available in the form of a self-administered web-based data access and data submission of household level processing of travel and activity diaries. This instrument has an integrated GIS feature to facilitate data entry & geo-coding, and extensive on-line help via a graphic user interface. It can be integrated with the GPS units in TRACER for use as a memory jogger, and/or to ascertain routing behavior.

Microscopic Simulation

Testbed traffic simulation utilizes the Paramics microscopic simulator. The current installation is as follows:

- Paramics v3.0-Build 7 (single-processor version)
- Paramics v2.0 (multi-processor version)

on the following platforms:

- SGI IRIX (6 Processors)
- Sun Solaris (2 Processors)
- Multiple PCs

Coded Testbed networks include:

- Orange County (CT D12) freeway system (detailed)
- City of Irvine “Golden Triangle” (detailed)
- City of Anaheim convention area (coarse)

To aid in simulation studies, the following APIs have been developed:

- Full-actuated signal control
 - eight-phase, dual-ring, concurrent controller logic (Type 170)
- Actuated signal coordination
 - additional force-off logic, background cycle length, and sync phase yield to full-actuated signal API
- Time-based ramp control
 - can interface with external ramp metering algorithms
- Intersection delay calculation
 - stop delay, control delay, incomplete / running delay at each time step, queue length, travel time
- MYSQL database interface
 - store the simulation outputs to either ASCII files or database
 - store intermediate simulation results for queries by other external APIs
- Loop data aggregator emulates the outputs of real-world data collection from inductive loops
 - raw data or smoothed
 - aggregated loop data (including volume, occupancy, speed) can be output to ASCII files or MYSQL database
- Ramp metering algorithms
 - local traffic-responsive algorithms:
 - fixed-time
 - demand-capacity
 - occupancy control
 - ALINEA
 - coordinated algorithms:
 - BOTTLENECK algorithm (Washington State)
 - ZONE algorithm (Minnesota)
- MOEs
 - total system travel time
 - total traffic throughput of the mainline freeway
 - mainline average travel time

- average on-ramp waiting time and average queue length
- travel time for vehicles between specific OD pairs

Mobile Surveillance

A prototype mobile surveillance unit is available, featuring:

- wireless Communication
- acoustic detector system for wireless ramp metering
- RTMS detector system for collecting mainline traffic data
- low voltage LED signal head
- solar powered system

Currently, only one such unit is available for deployment, but more are likely to be available in the coming months.

Mobile Transportation Management Capability

A “mobile TMC” has been developed, featuring:

- Surveillance
 - mast-mounted pan, tilt, and zoom surveillance camera
 - receive & transmit compressed video to D12 TMC
 - RTMS detector system for collecting mainline traffic data
- Wireless Communication
 - voice & video conference with personnel in D12 TMC.
 - operate D12 ATMS from within MTMC
- Ramp Control
 - relay ramp metering trailer 170 controller data to the D12 TMC from remote locations.
 - detection via mast-mounted RTMS vehicle detection system connected to on-board 170 controller connected to D12 FEP
 - Acoustic detector system for wireless ramp metering
 - Solar-powered low Voltage LED signal head

For further information about the ATMIS Testbed, please contact Dr. Hamed Benouar at: benouar@calccit.org

Berkeley Highway Laboratory

The Berkeley Highway Laboratory (BHL) is a test site covering 2.7 miles of I-80 immediately north of the San Francisco-Oakland Bay Bridge with 4-5 lanes in each direction, including HOV lanes. The video and loop detector components of the BHL are now in operation. The video component consists of twelve fixed-focus cameras and two Pan-Tilt-Zoom (PTZ) dome cameras mounted on top of a 30-story building alongside I-80 in Emeryville. Wireless communication between the Richmond Field Station and this site enable researchers to receive data from the PTZ cameras and to control the cameras remotely. The fixed-focus cameras cover a mile-long surveillance region with overlapping fields of view. There is approximately 1000 hours of video tapes archived for researchers to use. The feeds from these cameras will be used by a machine vision system, which will produce continuous vehicle trajectories over the combined fields of view. The raw video data is also available for verification of other types of surveillance

methods, for validating and improving simulation models, and for studying traffic dynamics.

The site also includes 7 loop detector stations between Ashby Avenue and Gilman Street. These stations have double loops, and travel times between stations are estimated by reidentifying vehicles or groups of vehicles based on their lengths as they travel from station to station. Flow and occupancy are also recorded. Both real time and historical data (since 1999) are available. See <http://www.its.berkeley.edu/projects/freewaydata/> for more details.

The Berkeley Highway Laboratory offers an extensive sample of video and loop data describing traffic on a varied and often congested section of freeway. The data can be used for a number of research purposes. Researchers are invited to utilize these data. For more information, contact Dr. Hamed Benouar at benouar@calccit.org

Experimental Vehicle Descriptions

Include necessary funding for use of the Experimental Vehicles in your proposal budget request. This includes staff and researcher times, cost of towing the vehicles to and from the test sites, and part of the insurance cost, plus gasoline and regular maintenance costs required for the project.

PATH has several types of heavily instrumented vehicles available for experimental use:

- Seven 1996/97 Buick LeSabre passenger cars
- Three 2001 Freightliner Century Class Diesel trucks (with trailers)
- Three 2001 New Flyer Transit buses.
- One 1991 Freightliner Class 8 truck with trailer

All of these vehicles have computer controllable throttle, brake and steering, a control computer and a variety of inertial, lateral and longitudinal position sensors installed.

Buick LeSabres

These vehicle were originally developed by PATH and GM Research for Demo '97 and feature somewhat dated computer and sensing equipment.

Specifications:

- 1996/97 model year Buick LeSabre with 3.1 liter V-6 engines, front wheel drive and automatic transmission
- Steering, brake and throttle actuators
- Industrial Computer Source, 166 Mhz Intel Pentium ISA bus computer w/ various A/D, D/A, DIO, counter-timer and serial ports, running QNX 4.22 real-time operating system
- Three front and three rear Applied Physics Systems Model 535 Magnetometers for lateral positioning using magnetic markers
- Forward looking 77 GHz Delco radar (other sensors such as lidar and Doppler radar available on a limited number of vehicles)
- Yaw rate gyroscope

- Three axis accelerometer
- Utilicom vehicle-to-vehicle communication

2001 Freightliner Trucks

There are three of these “eighteen wheeler” type over the road trucks developed for Demo 2003

Specifications:

- 2001 model year Freightliner Century Class three axle, over-the-road tractor, Cummins N-14 435 Hp, 1450 lb-ft torque, Allison HD-4060 torque converter type six speed automatic transmission, dual rear drive axles
- Custom steering actuator by NSK, Japan
- WABCO “Euro-type” brake by wire EBS system
- Engine speed and torque controlled by direct J-1939 commands to factory engine controller
- 400 Mhz Intel Celeron PC-104 computer system, w/ various A/D, D/A, DIO, counter-time, encoder and serial ports (RS-232, CAN, etc), running QNX 4.25 real-time operating system
- Five front and five rear Applied Physics Systems Model 535 Magnetometers for lateral positioning using magnetic markers
- KVH E-core fiber-optic yaw rate gyroscope
- Summit Instruments 1.5 g two axis accelerometer
- Forward looking Eaton-VORAD EVT-300 25 GHz Doppler radar
- Forward looking Denso LIDAR
- 802.11b based vehicle to vehicle communications
- Three different trailers are available to be towed; 40 ft cargo container, “low-boy” type equipment transporter and a “wedge type car carrier.

New Flyer Buses

These vehicles are low-floor transit buses developed for Demo 2003. There are actually two types of buses; one 60 ft articulated, diesel powered bus and two 40 ft CNG (spark ignition) powered buses.

Specifications:

- 60’ Bus; Detroit Diesel 330 Hp, Series 50 Diesel engine, Allison 5 speed torque converter type automatic transmission
- 40’ Buses, Cummins C8.3G+ CNG spark ignition engines, Allison five speed torque converter type automatic transmission
- Custom steering actuator by NSK, Japan

- Custom PATH designed brake by wire system (computer controlled proportional pneumatic valve)
- Engine speed and torque controlled by direct J-1939 commands to factory engine controller (60 ft bus)
- Engine throttle valve controlled by analog output from control computer (40 ft buses)
- 400 Mhz Intel Celeron PC-104 computer system, w/ various A/D, D/A, DIO, counter-timer, encoder and serial ports (RS-232, CAN, etc), running QNX 4.25 real-time operating system
- Seven front and Seven rear Applied Physics Systems Model 535 Magnetometers for lateral positioning using magnetic markers
- KVH E-core fiber-optic yaw rate gyroscope
- Summit Instruments 1.5 g two axis accelerometer
- Forward looking Eaton-VORAD EVT-300 25 GHz Doppler radar
- Forward looking Denso LIDAR
- 802.11b based vehicle to vehicle communications

1991 Freightliner Truck w/ 45ft box trailer

This vehicle is a vehicle developed by PATH for heavy vehicle research.

Specifications:

- 1991 model year Freightliner Class 8 over-the-road three-axle tractor, Detroit Diesel 365 Hp Series 60 Diesel engine, Allison six speed HD-4060 torque converter type automatic transmission, one (rear) drive axle
- Industrial Computer Source, 266 Mhz Intel Pentium II ISA bus computer w/ various A/D, D/A, DIO, counter-timer and serial ports, running QNX 4.25 operating system
- Custom steering actuator by NSK, Japan
- Five front, five rear and five trailer, Applied Physics Systems Model 535 Magnetometers for lateral positioning using magnetic markers
- Various accelerometers, gyroscopes, radars and lidars

For further information about the experimental vehicles, please contact David Nelson at: (510)-231-9577, or dnelson@path.berkeley.edu

Intelligent Intersection

Include necessary funding for use of the Intelligent Intersection in your proposal budget request. This includes staff and researcher times.

The *Intelligent Intersection* is conceived to be largely flexible and configurable; it allows for variable placement of commercially-available in-pavement vehicle state (e.g., speed,

acceleration) detectors, dynamic placement of roadside signage, variations of background (trees vs. buildings) and the ability to include or remove an occlusion of the driver line of sight. It is located at the corner of Owl Way and Crow Drive at the Richmond Field Station (RFS), has four roughly perpendicular approaches, each with two lanes of traffic. For each approach, there are pedestrian crosswalk markings and stop bars. Traffic control devices include standard three-phase signal heads (red, yellow and permissive green) mounted at each intersection corner, along with on-demand pedestrian crosswalk signals. There is also one overhead luminaire.

The *Intelligent Intersection* allows communications- or sensor-based signal control and preemption. It is equipped with a 2070 Advanced Traffic Controller, housed in an ITS Cabinet. Both 802.11a (similar to Dedicated Short Range Communication) and 802.11b wireless transceivers are located at the ITS Cabinet, connected to the controller through a PC-104 computer, also housed in the cabinet.

In three of the approach legs, there is a standard series of in-pavement inductive loops with the last installed partially in the pedestrian crosswalk, which can be used to actuate signals. In one of these three legs, there are only two loop detectors. In the fourth leg (Owl Way), coincident with the PATH test track, there exists a 200-ft string of 3M micro-loop starting from the far crosswalk of the intersection and extending down the centerline of that leg. The micro-loops are emplaced in one-foot intervals in a conduit two feet below the road surface. In addition, there exists the capability to mount and connect a host of other sensor devices as needed for various projects that may need use of the *Intelligent Intersection*.

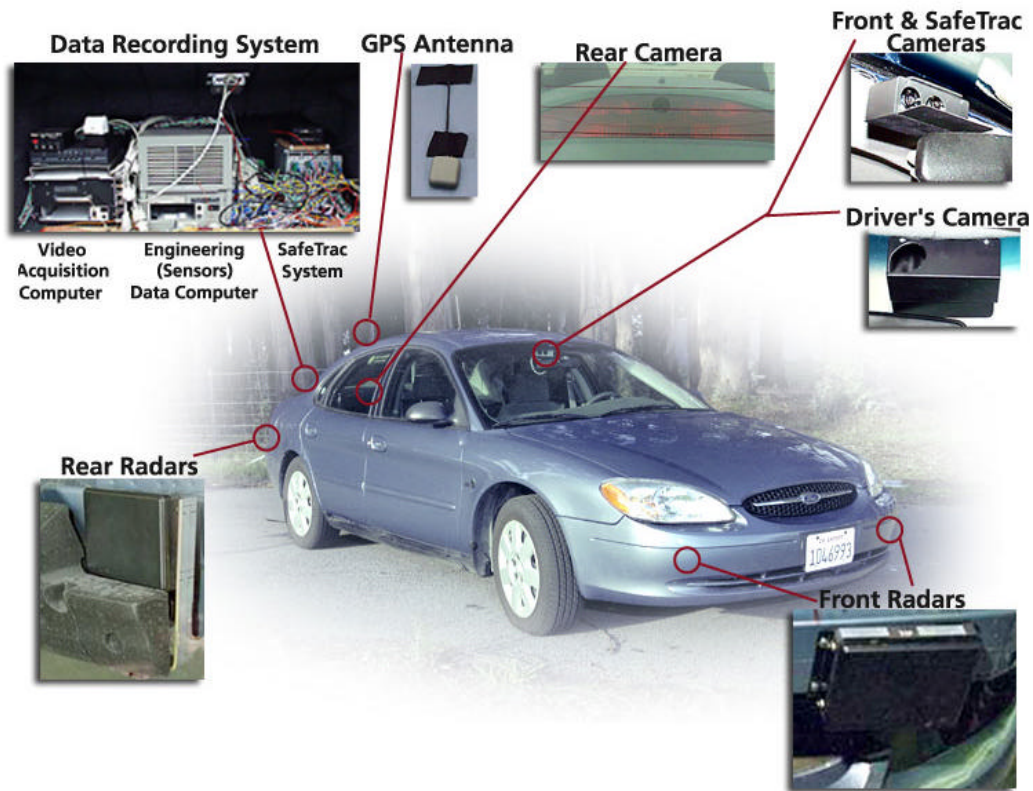
One leg of the intersection is aligned with the Owl Way PATH test track, and therefore can be potentially used for higher-speed controlled driving tests. The other three legs, which are aligned with RFS roadways and traffic, should be controlled with caution when experiments are conducted. Two of the four approach legs are approximately 140-m long, and the other two are significantly shorter. On the 140-m Crow Drive intersections, there exists an “occluding fence”, designed to limit the sight lines of lateral-approaching drivers. A feature of the fence is that internal slats can be removed if such an occlusion is undesirable.

For further information about the Intelligent Intersection, please contact Jim Misener at: (510) 231-5651, or misener@path.berkeley.edu

Instrumented Car

Include necessary funding for use of the Instrumented Car in your proposal budget request. This includes staff and researcher times and part of the insurance cost (\$40/mo), plus gasoline and regular maintenance costs required for the project.

The PATH instrumented car, a Ford Taurus, is illustrated below. In addition to this instrumentation suite an *in situ* eye tracker has been installed.



Specific data that can be collected include:

- vehicle status: (velocity, position [general position via DGPS and in-lane through SafeTrac], steering angle, throttle angle, brake use, cruise control use, blinker, lateral and longitudinal acceleration);
- surrounding traffic (distance to and velocity of leading or oncoming and following vehicles);
- qualitative video of the forward and rear scene; and
- driver eye movements.

This vehicle is located at the Richmond Field Station and is slated for significant experimental use. However, the vehicle and research and support staff can be scheduled, given that projects can be flexible.

For additional information on the Instrumented Car, please contact David Nelson at (510)-231-9577, or dnelson@path.berkeley.edu

C. UNIVERSITY OF CALIFORNIA BUSINESS INFORMATION FORM

FOR YOUR INFORMATION - PLEASE KEEP

UNIVERSITY OF CALIFORNIA

Business Information Form

DEFINITIONS

ASIAN-INDIAN AMERICAN: United States citizens and legal resident aliens whose origins are in India, Pakistan, or Bangladesh.

ASIAN-PACIFIC AMERICAN: United **States** citizens and legal resident aliens whose origins are in Japan, China, Korea, Taiwan, Cambodia, Laos, **Vietnam, the Philippines, Samoa, Guam, the US Trust Territories of the Pacific Islands, and the Northern Marianas Islands.**

BLACK/AFRICAN AMERICAN: United States citizens and legal resident aliens whose origins are in any of the Black racial groups of Africa.

DISABLED VETERAN: United **States** citizens and legal resident aliens who are veterans of the military, naval, or air service of the United States with service-connected disabilities who are residents of the State of **California**. To qualify as a **veteran** with a **service-connected** disability, **the person** must be currently declared by the United States Veterans Administration to be ten percent **(10%)** or more disabled as a result of service in the armed forces.

DISABLED VETERAN BUSINESS ENTERPRISE [DVBE]: a DVBE is a business owned and controlled by one or **more** disabled veterans. Owned and controlled means that: a. A sole proprietorship owned by a disabled veteran; or a **partnership** or corporation, **51%** of the **stock** or partnership interests of which are owned by one or more disabled veterans; b. Management and daily business operation are controlled by one or more disabled veterans; c. A sole proprietorship, corporation, or partnership with its home **office** located in the United States, which is not a **branch** or subsidiary of a foreign **corporation, firm** or other foreign **based** business. **PLEASE NOTE: The University of California requires that a DVBE applicant submit proof of DVBE certification provided by the State of California, Department of General Services, Office of Small Minority Business (OSMB).**

DISADVANTAGED BUSINESS ENTERPRISE [DBE]: a business concern which is at least **fifty-one** percent (51%) owned by one or more socially and economically disadvantaged individuals or, in the case of **any** publicly owned business, at least fifty-one percent (51%) **of the** stock of which is owned by such individuals; and whose management and daily business operations are controlled by one or more of such individuals. The following individuals are considered socially and economically disadvantaged: Native American & American Indians, Asian-Pacific Americans, Asian-Indian Americans, Black African Americans, and Hispanic Americans.

HISPANIC AMERICAN: United **States** citizens and legal resident aliens whose origins are in Mexico, Puerto Rico, Spain, **Portugal**, Central or South America.

NATIVE AMERICAN/AMERICAN INDIANS: United States citizens and legal resident aliens whose origins are in any of **the** original peoples of North America, i.e., American Indians, Eskimos, Aleuts, and native Hawaiians.

SMALL BUSINESS ENTERPRISE [SBE] (Supplier - Goods and Services): an **independently** owned and operated **firm**, certified, or **certifiable**, as a small business by the Federal Small Business Administration (**SBA**).

SMALL BUSINESS ENTERPRISE [SBE] (Construction Contractor/Design Professional): a firm whose **annual average** gross receipts, taken for the last **three** fiscal years, do not exceed the amount listed in the MAXIMUM RECEIPTS TABLE below. Annual average gross receipts computation: the quotient of the arithmetical sum of the gross receipts of the prior **three** fiscal **years** divided by three (3).

SOCIALLY AND ECONOMICALLY DISADVANTAGED: United States citizens and legal resident aliens who are defined as socially and economically disadvantaged **individuals** by the United States Small Business Administration.

WHITE AMERICAN: United States citizens and legal resident aliens whose origins are in Europe, North Africa, or southwest Asia.

WOMAN-OWNED BUSINESS ENTERPRISE [WBE]: a business concern which is at least 51% owned by one or more women; and management and daily business operations are controlled by one or more women who own the business concern.

MAXIMUM RECEIPTS TABLE

CONTRACTOR'S LICENSE TYPE

A. General Engineering

B. General Building

C. Specialty

DESIGN PROFESSIONALS

ANNUAL AVERAGE

(Preceding Three Years)

\$17,000,000

17,000,000

7,000,000

2,500,000

Formal Certification of DBE/WBE/DVBE Status (Does not apply to laboratories)

All DESIGN, PROFESSIONAL, CONSTRUCTION and GOODS and SERVICES **firms receiving \$10,000** or more business annually **from** a University location and seeking to do business as a DBE, WBE, or DVBE with the University or with a prime contractor doing business with **the University must be certified.**

In the CONSTRUCTION area certification is **required** by bidders that are **SDBEs, SWBEs, or SDVBEs** that wish to claim the 5% bid **preference** and those **SDBE/SWBE/SDVBE** subcontractors listed by a bidder to meet the 5% participation rate.

Information on certification can be obtained **from** a University location or the University of California, Office of the President.

IMPORTAM: Submit a completed **copy** of this form to the Small Business Coordinator at the University location(s) of your Choice.

UNIVERSITY OF CALIFORNIA BUSINESS INFORMATION FORM

SECTION I - To be Completed By ALL FIRMS OR INDIVIDUALS PROPOSING TO DO BUSINESS WITH THE UNIVERSITY (regardless of commodity service or product offered)

COMPANY NAME		CONTACT PERSON (Indicate Ms. Mr. etc)			
Number/Street		City		State	ZIP
ADDRESS					
MAILING ADDRESS (if different)					
REMITTANCE ADDRESS (if different)					
DO YOU ACCEPT COLLECT CALLS?YES NO					
TELEPHONE NUMBER ()		FAX NUMBER ()		TOLL FREE NO (800)	
FEDERAL IDENTIFICATION ND. OR SOCIAL SECURITY NO.:			DUN & BRAD STREET NO.:		
PRIMARY TYPE OF BUSINESS:					
BROKER DEALER	DISTRIBUTOR MANUFACTURER	MANUFACTURERS AGENT RETAILER	SERVICE WHOLESALE	FABRICATOR DESIGN PROFESSIONAL	GENERAL CONTRACTOR OTHER:
OWNERSHIP OF BUSINESS:			FOREIGN OWNERSHIP		NON PROFIT INSTITUTION
CORPORATION JOINT VENTURE PARTNERSHIP SOLE PROPRIETOR			LOCAL/STATE/FEDERAL GOVERNMENT AGENCY		EDUCATIONAL INSTITUTION
Are any of the owners or owners relatives currently employed by the University of California? YES NO					
If yes, please provide details on an attached sheet of paper.					
PRINCIPAL OWNERS:					
Name		Title	Sex (M or F)	Ethnicity	Percent Ownership
					%
					%
					%
THIS IS A PARENT COMPANY		Name of subsidiaries:			
THIS IS A SUBSIDIARY		Name and location of parent company:			

SECTION I I- To Be Completed By SUPPLIER OF GOODS or SERVICES **ONLY** (Design Professionals Please See Section IV Below)

NUMBER OF YEARS BUSINESS	AVERAGE ANNUAL SALES (PRIOR THREE YEARS)	NET WORTH OF BUSINESS	NORMAL INVENTORY VALUE	APPROXIMATE SIZE OF FACILITIES (SQ.FT.)	NUMBER OF EMPLOYEES
Please List the name(S) or description(s) of the major product(s) or service(s) that your firm offers.					
BANK REFERENCE NAME:		ADDRESS (Number. City. State ZIP)			
CUSTOMER REFERENCES:					
Name		Address		Phone Number	

PERSON(S) AUTHORIZED TO COMMIT YOUR FIRM TO A CONTRACT:			
Name	Title	Name	Title
Name	Title	Name	Title

SECTION I I I- To Be Completed By CONSTRUCTION CONTRACTOR ONLY

License Type	A	B	C	California License No.:	Expiration Date:
If C license, specify and describe Specialty:					
Average Annual Gross Receipts: \$ Year Company Started:					
(based on prior three fiscal years)					

SECTION IV -To Be Completed By DESIGN PROFESSIONAL ONLY

ARCHITECT	ENGINEER	LANDSCAPE ARCHITECT	OTHER:	REGISTRATION NO.:
Please list below the major and supplemental service you offer				
Major Services:		Supplemental Services:		
Average Annual Gross Receipts S		Year Company Started:		
(based on prior three fiscal years)				

SECTION V - Ownership Status Categories: Place an "X" /ownership percent in the boxes that best describe your firm's ownership status. (See Definitions on page 4.)

		Nat.Am./ Am. Ind.	Asian/Pacific Asian/Indian American	Black African Am.	White American	Hispanic American	Disabled Veteran	Socially & Economically Disadvantaged
LARGE	WOMAN OWNED							
BUSINESS	MALE OWNED							
SMALL	WOMAN OWNED							
BUSINESS	MALE OWNED							

Has your firm applied for or received DBE/WBE/DVBE certification from the University of California?	Yes	No
If yes, please give date of application _____	or date of certification _____	

University of California facilities with which you wish to conduct business				
All Northern CA Locations	All Southern CA Locations	Ag. Field Stations	LBL	LLNL
Berkeley	Davis	Davis Med. Center	Irvine	Irvine Med. Center
Los Angeles	Los Angeles Med. Center	Riverside San Diego	San Diego	San Diego Med. Ctr.
San Francisco	San Francisco Med. Center	Santa Barbara	Santa Cruz	

PRIVACY NOTIFICATIONS

STATE
The State of California Information Practices Act of 1977 (effective July 1-1978) requires the University of California to provide the following information to individuals who are asked to supply information about themselves.

The principal purpose for requesting the information on this form is to evaluate your qualifications as a supplier to the University and for reporting purposes in accordance with state law and University policy.

Furnishing all information (except Social Security Number) requested on this form is mandatory - failure to provide all requested information will delay or may prevent evaluation of your firm's ability to do business with the University.

The official responsible for maintaining the information contained in this form is the Senior Vice President -Administration in the University of California's Office of the President.

FEDERAL
Pursuant to the Federal Privacy Act of 1974, you are hereby notified that the disclosure of your social security number is voluntary. This record keeping system was established pursuant to the authority of The Regents of the University of California under Art. IX, Sec. 9 of the California Constitution. The social security number is used to verify your identity.

I hereby certify under penalty of perjury under the laws of the State of California that I have read this application and know the contents thereof, and that the business category and ethnicity indicated above reflect the true and correct status of the business in accordance with Federal Small Business Administration criteria and Federal Acquisition Regulations, FAR 19, pertaining to small, disadvantaged, woman, disabled veteran, small and disadvantaged, and small and woman-owned business enterprises. I understand that falsely certifying the status of this business, obstructing, impeding, or otherwise inhibiting any University of California who is attempting to verify the information on this form, may result in suspension from participation in University of California business contracts for a period up to five (5) years and the imposition of any civil penalties allowed by law. In addition, I understand that this business must notify the University of California in writing thirty (30) days in advance of any changes in size, ownership, control, or operation which may affect this business's continued eligibility as a SBE, DBE, WBE, DVBE, SDBE, SWBE or SDVBE.

INFORMATION FURNISHED BY (Print or type name of owner and/or principal)

NAME _____	TITLE _____
SIGNATURE _____	DATE _____

FOR U. C. USE ONLY	REVIEWED BY	DATE	COMMENTS

D. COST-ELEMENT BREAKDOWN

COST ELEMENTS BREAKDOWN

ITEM	COST ELEMENTS				REFERENCE SCHEDULE AND PAGE NUMBER
1	DIRECT LABOR	RATES	HOURS	AMOUNT	
				\$	
	TOTAL DIRECT LABOR				
		RATES	BASE		
2	OVERHEAD		\$		
	TOTAL OVERHEAD				
	MATERIAL				
	MATERIAL BURDEN				
	TOTAL MATERIAL				
	SUBCONTRACT				
	SUBCONTRACT BURDEN				
3	OTHER DIRECT COSTS				
	SUBTOTAL COST				
4	G&A				
	TOTAL COST				

TIME PHASED COST SUMMARY SCHEDULE

[illegible]

PREPARED BY:

TITLE:

DATE:

E. NON-DISCRIMINATION AND NON-SEGREGATION STATEMENTS

NON-DISCRIMINATION STATEMENT

During the performance of this contract, the contractor, for itself, its assignees and successors in interest (hereinafter referred to as the "contractor") agree as follows:

- (1) **Compliance with Regulations:** The contractor shall comply with regulations relative to Title VI (non-discrimination in federally-assisted programs of the Department of Transportation - Title 49 Code of Federal Regulations Part 21 - Effectuation of Title VI of the 1964 Civil Rights Act.) Title VI provides that the recipients of federal assistance will implement and maintain a policy of non-discrimination in which no person in the state of California shall, on the basis of race, color, national origin, religion, sex, age, disability, be excluded from participation in, denied the benefits of or subjected to discrimination under any program or activity by the recipients of federal assistance or their assignees and successors in interest.
- (2) **Non-discrimination:** The contractor, with regard to the work performed by it during the contract shall act in accordance with Title VI. Specifically, the contractor shall not discriminate on the basis of race, color, national origin, religion, sex, age, or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall not participate either directly or indirectly in the discrimination prohibited by Section 21.5 of the U.S. DOT's Regulations, including employment practices when the contract covers a program whose goal is employment.
- (3) **Solicitations of Subcontracts, Including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Regulations relative to non-discrimination on the grounds of race, color or national origin.
- (4) **Information and Reports:** The contractor shall provide all information and reports required by the Regulations, or directives issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the State Department of Transportation or the Federal Highway Administration to be pertinent to ascertain compliance with such Regulations or directives. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information, the contractor shall so certify to the State Department of Transportation, or the Federal Highway Administration as appropriate, and shall set forth what efforts it has made to obtain the information.
- (5) **Sanctions for Noncompliance:** In the event of the contractor's noncompliance with the non-discrimination provisions of this contract, the State Department of Transportation shall impose such contract sanctions as it or the Federal Highway Administration may determine to be appropriate, including, but not limited to:
 - (a) withholding of payments to the contractor under the contract until the contractor complies, and/or
 - (b) cancellation, termination or suspension of the contract, in whole or in part.
- (1) **Incorporation of Provisions:** The contractor shall include the provisions of paragraph (1) through (6) in every subcontract including procurements of materials and leases of equipment, unless exempt by the Regulations or directives issued pursuant thereto. The contractor will take such action with respect to any subcontractor or procurement as the State Department of Transportation or the Federal Highway Administration may direct as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the contractor may request the State Department of Transportation to enter into such litigation to protect the interest of the State, and, in addition, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

Certification of Non-Segregated Facilities

As a supplier of goods or services to the University of California I/we certify that racially segregated facilities will not be maintained nor provided for employees at any establishment under my/our control; and that I/we adhere to the principles set forth in Executive Orders 11246 and 11375, and undertake specifically: to maintain employment policies and practices that affirmatively promote equality of opportunity for minority group persons and women; to take affirmative steps to hire and promote women and minority group persons at all job levels and in all aspects of employment; to communicate this policy in both English and Spanish to all persons concerned within the company, with outside recruiting services, and the minority community at large; to provide the University on request a breakdown of our total labor force by ethnic group, sex, and job category; and to discuss with the University our policies and practices relating to our affirmative action program.

Authorized Signature

Date

F. PATH PROGRESS STATEMENT

PATH Progress Statement as of January 2005 (Current and Former PATH PIs Only)

Project Title:	
Principal Investigator:	
Funding Allocated:	
Funding Spent to Date:	
Starting Date:	
End Date:	
In the space below, describe research progress relative to original research plan. Explain any deviation from plan.	
In the space below, list all project deliverables completed to date (research reports, software, publications, etc.).	